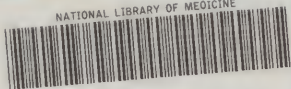




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JOHN W. JACKSON, M. D.

THE FIRST PRESIDENT OF THE NATIONAL ASSOCIATION OF RAILWAY SURGEONS.

# RAILWAY SURGERY.

A PRACTICAL WORK ON THE

SPECIAL DEPARTMENT OF RAILWAY SURGERY:

FOR RAILWAY SURGEONS;

AND PRACTITIONERS IN THE GENERAL PRACTICE OF SURGERY.

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— BY —

C. B. STEMEN, A.M., M.D., LL.D.,

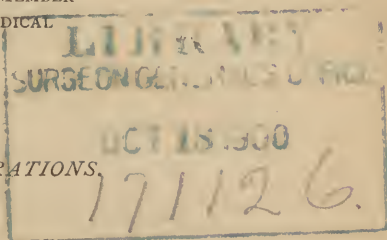
OF

PROFESSOR OF SURGERY IN THE FORT WAYNE COLLEGE OF MEDICINE; SURGEON  
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WABASH WESTERN RAILWAY; MEMBER OF THE  
BRITISH MEDICAL ASSOCIATION; MEMBER  
OF THE INDIANA STATE MEDICAL  
SOCIETY; ETC.

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WITH NUMEROUS ILLUSTRATIONS.

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## DEDICATION.

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TO

J. G. BUCHANAN, M.D., Surgeon, Pennsylvania Company, Allegheny, Pa.;

J. W. JACKSON, M.D., Chief Surgeon of the Wabash Railway, and the Wabash  
Western, Kansas City, Mo.;

W. B. OUTTEN, M.D., Chief Surgeon of the Missouri Pacific Railway, St. Louis, Mo.

CHARLES M. HAYS, Esq., General Manager of the Wabash Western Railway;

and my special friend,

C. D. LAW, Esq., Superintendent of the Western Division of the Pittsburg, Fort  
Wayne & Chicago Railway,

This Work is Most Affectionately Dedicated by

THE AUTHOR.

## P R E F A C E.

---

This book is the result of my experience in the practice of accidental or railway surgery, and my strong belief that a treatise on this special department was greatly demanded.

While the volume is not what I had desired, being written while engaged in active practice, connected with the duties of teaching and other literary work, several chapters being written while traveling in other countries, thus rendering it impossible to give to it that constant and continuous thought and labor which it demanded, it is the hope of the author that the profession will find it of value, and that many practical suggestions may be found that will prove of special interest to the large and constantly increasing number of surgeons engaged in the practice of this special branch of surgery.

C. B. STEMEN.



## INTRODUCTION.

---

On January 25, 1882, the first meeting of railway surgeons was held in the city of Decatur, Ill., and an organization formed. The Association comprised the surgeons of the then Eastern division of the Wabash, St. Louis & Pacific Railway, with Dr. J. T. Wood, of Toledo, O., as the Chief Surgeon, who was elected president of the Association. The author of this work was elected secretary of the Association, and the proceedings of the meeting were ordered published in the Fort Wayne *Journal of the Medical Sciences*, of which he was the editor and publisher. This was the first organization that recognized railway surgery as a specialty, but it was soon followed by that of the Pittsburg, Fort Wayne & Chicago Railway, one of the leased lines of the Pennsylvania Company, organized at Crestline, O., October 18, same year, of which the author was chosen president.

These two organizations took the lead in developing railway surgery as a specialty, and have kept up their regular annual and semi-annual meetings until the present time. It was these two organizations that took the initiatory steps in the formation of the National Association of Railway Surgeons, which occurred in the city of Chicago, June 28, 1888.

The great army of railway surgeons recognize the fact that in the treatment of railway injuries no special instructions are given in our medical colleges, and that no text book on surgery especially treats of this class of cases. Consequently there is but little literature on this rapidly growing specialty, in which over 25,000 of the leading surgeons of this great

country are engaged. The Fort Wayne *Journal of the Medical Sciences* has been the only periodical in this country devoted almost exclusively to this special branch of surgical practice. Upon the organization of the National Association of Railway Surgeons at Chicago, this journal was adopted as the organ of the Association, and has since then been published as the *Journal of the National Association of Railway Surgeons*. From the papers read at the meetings of these associations, the author has made very valuable extracts; and it was owing to the discussion and the great interest manifested by the railway surgeons that the publication of this work was undertaken.

The author desires to make special mention of the papers of Dr. J. T. Wood, of Toledo, O.; Dr. J. W. Jackson, of Kansas City, Mo.; Dr. W. B. Outten, of St. Louis, Mo.; Dr. R. Harvey Reed, of Mansfield, O.; Dr. Neal Hardy, of Upper Sandusky, O.; Dr. Pinckney French, of Mexico, Mo.; Dr. E. W. Lee, of Chicago, Ill.; Dr. J. B. Murdoch, of Pittsburg, Pa.; Dr. J. J. Buchanan, Pittsburg, Pa.; Dr. A. W. Ridenour, of Massillon, O.; Dr. L. E. Russell, of Springfield, O.; Dr. F. L. Mathews, of Springfield, Ill.; Dr. W. J. Chenoweth, of Decatur, Ill.; Dr. C. B. Higgins, of Peru, Ind.; Dr. Wm. Scott, of Kokomo, Ind.; Dr. Marsee, of Indianapolis, Ind.; Dr. B. R. Freeman, of Decatur, Ind.; Dr. J. H. Tressel, of Alliance, O.; Dr. A. L. McCurdy, of Dennison, O., and Dr. W. A. Hammond, of Washington, D. C.

These have all contributed to the literature of railway surgery, extracts of which will be found in this work. In some cases generous extracts have been made from papers on subjects discussed, and proper credit has been given to the author or authors thereof, in the body of the work. The author of this treatise having been engaged for more than fifteen years in the practice of railway surgery, at the headquarters of the Western division of the Pittsburg, Fort Wayne & Chicago Railway, most of the time in the capacity of chief surgeon of the division, and also for a number of years as local surgeon

on the Wabash Railway, he has had a large experience in the treatment of this class of injuries.

During the summer of 1887 he was permitted to travel through foreign countries, and to investigate the methods employed by foreign railways in taking care of their injured men, and with the experience of an active practice, and the observations made abroad, he has been enabled to present to the railway surgeons a book which it is believed will be found of great value to those engaged in looking after the injured on our railways or in the shops connected therewith. It has been the aim to present such practical facts as will be of value to all railway surgeons in their ministrations to those who are wounded in service on the iron highways of our country.



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# RAILWAY SURGERY.

## CHAPTER I.

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### TRANSPORTATION OF INJURED RAILWAY MEN.

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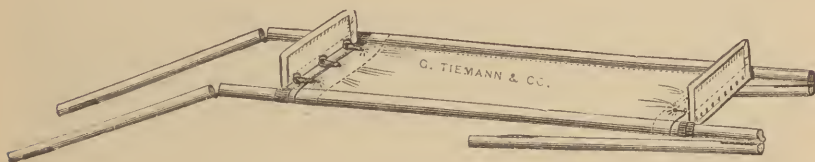
This is one of the most perplexing subjects with which the surgeon has to deal. Having given the necessary temporary treatment, the patient must be moved either to his home or a hospital. At a meeting of the surgeons of the Wabash, St. Louis & Pacific Railway, held at Decatur, Ill., January 25, 1882, the first meeting of Railway Surgeons held in this or any other country, Dr. J. T. Woods of Toledo, Ohio, read a paper on the subject now considered so valuable and exhaustive in its character that it seems well to reproduce it almost in its entirety. He says:

"In its strictest sense the duty of the medical man is humanitarian. His highest function is to preserve life, and next to that, to save from suffering. This is especially true of the surgeon whose path of duty leads directly to the sufferer, and whatever high examples may present, I maintain that in him, rudeness, indifference to humanity, and the omission of any possible means of alleviating it is wholly inexcusable. In actual practice both causes and consequences are ever present, the means of alleviation not always apparent or of easy attainment, but still worthy of the most earnest inquiry and careful effort toward removal. Neither is it always in great and showy

ways that we are to do the most actual good to those who fall under our care; but little things, the veriest trifles, professionally considered, are often of mammoth proportions to the sufferer. The party he is to consider is the sufferer only. Our duty to a patient begins on the first moment of our arrival, and everything thereafter should be directed with scrupulous care, for every twinge of pain is a blow at life. For this reason both patients and surgeons are thankful for anesthetics, and the former is relatively as grateful for avoidance of the dread agony in every step preparatory to the operative work proper. These reflections have prompted me to present some rather crude suggestions in relation to the handling and transporting of those who are injured, both before and after operation. The ideas are to some extent applicable wherever bodily suffering exists, combined with the necessity of removal, but I desire at this time to call attention to physical injuries, and more especially such as are incident to surgical railway service. I am not unaware that few rules or specific directions can be laid down, as conditions in every way vary, yet reflection and suggestions may prepare us more readily and effectually to do the duty of a special occasion. Whether the accident involve few or many, the surgeon usually arrives after the lapse of some time, during which interval much has been done as seems best to those present, but on the arrival of a medical man, he becomes the director of every movement, and with discretion can conduct future proceedings, much as his judgment seems best. The railway surgeon is supposed to, and always should, have his instruments and appliances ready at hand, so as to be able to move with brief notice. These instruments and appliances should not be numerous, and all parties will find that whatever the surgeon may bring, nothing will be more valuable where there are badly injured persons, than a pair of stretchers. For the reasonable proper handling of the kind of patients that are usually found by us, they are absolutely necessary. There should be a pair, certainly, at every point where there is a surgeon, and they should accompany him in his response to a call. In lieu of a better one, an appliance that will serve a good pur-



pose may be easily and cheaply made by even a rude workman. If two pieces of scantling  $2 \times 2\frac{1}{2}$  in.  $\times 7\frac{1}{2}$  feet, rounded at the ends to form handles, are joined by lighter pieces placed across at 8 to 10 inches from the ends, an efficient frame will be formed. The outside measure of this frame should be 21 inches, which is wide enough to carry a stout man, and will pass the guard rail posts and door of a passenger car. By nailing over this a piece of canvas, or if that is not at hand, any stout material (as two thicknesses of ticking) you have a simple and cheap stretcher. The cloth should not be stretched very firmly, except at the ends, as a little bagging will afford much easier rest for the body. Of course it is very crude and insufficient, but so much better than none that it seems worth consideration.



"Having a case of fracture, lying on the ground, the first thing that would present would be the application of support on the outside of the clothing for the purpose of preventing sharp fragments from doing harm in handling. These may be made of any available material, pasteboard, a single strip of board, and held in place by bandage, cords, in short anything that will answer the purpose. I have thus temporarily dressed a fractured leg with a few corn stalks, or lashed one leg securely to the other with a couple of handkerchiefs. In case of a crushed limb the parts should be so managed as to drag as little as possible.

"The next step is to put the patient on the stretcher. The best method I have found is to place one or more men on the right side of the patient, their duty being to lift the body. Two take position on the opposite side to raise his legs, head and shoulders, standing as near as practicable to the upper and

lower part of the body, respectively. Show them where to take hold and what to do 'all together' when you command. At the word the men will lift the patient directly upward just far enough to permit the surgeon to slip the stretcher, with his legs folded up, under the patient's hips from his left side and sliding it quickly as near under and parallel to the body as possible. The patient thus far has only been raised upward a few inches and with a very slight lateral movement, almost without moving their feet, those that hold can lay him gently down on the canvas. To avoid contact with the ground the man who handles the stretchers should keep the end on which the body is placed a little elevated. At once the other end is raised and the sufferer has been made ready for removal with very little annoyance. If the body be very heavy, or the assistants few, those who lift may take the patient by the shoulders and raise the body and hips off the ground. The stretchers being then slipped under, one man may take the legs and by simply turning the body on the nates as a pivot, effect the desired result, In neither case has the body been jolted and dragged by raising far from the ground, and especially has the jolt, jar and dragging from carying in arms by inexperienced men been avoided. From this the sufferer should not be moved until he is placed on the operating table or in bed. The method suggested for accomplishing the latter is to fold up the legs of the stretcher and carry it somewhat diagonally across the table and near to the surface, the patient's right hand being toward the pillow. In this position the patient on the stretcher is allowed to rest on the table. Those who are to lift the body are placed on the patient's left side, those who handle the legs at his right side. Taking hold at the word of command and lifting together, the body is raised so as to clear the stretcher which is then easily withdrawn, and by a slight movement of those holding the body it is placed in the desired position. Removal from the table is effected in nearly the same way that the body was first placed on the stretcher, and he may be laid in bed with as little discomfort as occurred in placing him there. To do this most satisfactorily, you will carry the

stretcher beside the bed, the patient's right hand next to the pillow. Carry the foot of the stretcher diagonally across the bed. The men on his left side now raise the body, one handles the legs, while the surgeon slides the stretcher from under him—which is usually easier done from the foot—when by a slight movement the assistants lay the body in its place. It not infrequently occurs that we are required to place patients in the cars either before operation and perfect dressing or very soon thereafter, and how to do it most readily and comfortably has been to me not a little puzzling. The baggage car is most convenient of access, as a cot can be passed through the side doors. It is, however, a rough place for a vigorous man to ride, and does not answer well for the injured, even with the aid of a cot, except for short distances. I have also suspended a stretcher from the roof by means of ropes, which answered passably. This method is greatly improved by the use of long India rubber bands slipped over the ends of the stretcher handles, the ropes being attached to them and the timbers above, their elasticity partially breaking the jar of the car. These bands being usually unattainable and also liable to break, render the plan practically useless, and so far as the baggage car is concerned we have left only rope suspension and the cot. In emergencies such as we are contemplating, the sleeping car is usually occupied and its use impractical, for the further reason that it is nearly impossible to get an injured man through the various passages leading into the seat or berth apartment.

“There is then nothing remaining but the passenger coach, and the problem is to take what is at hand and make out of it a bed in which a patient with crushed legs, arms, or ribs, or suffering from concussion, can be placed easily, and on which he can ride without detriment. It can be done in this way: Take off the back of one seat. This is done by the removal of a few screws, and a screw-driver will always be found in the possession of the engineer. Turn right and left the seats next before and behind, so as to leave the space of three seats open. Then take the cushion of the seat from which the back has been removed, and turn it upside down on that at one end of the

proposed bed, place another in the same way on the cushion at the other end. We then have an open space of sufficient length and a double set of springs on which to place our support. If we now have our patient on a stretcher that is narrow enough to go through the car door, he is not to be removed from it, but the whole passed between the iron posts and through the door into the car, the carriers taking hold of the cross bars in lieu of the handles, in passing through the door. Of course the cars must be separated to secure the necessary space between them. The stretcher with its contents is now to be laid down, the ends on our double cushion springs. If the handles are too long to lie between the open seats, one back may be raised and they allowed to project beneath it. This, it seems to me, is not only a comfortable but a thoroughly practical means, provided we have the stretchers and that they are sufficiently narrow. By it the sufferer will not have to undergo the lifting and handling that is often nothing but torture, from the time he is picked up until he is laid on the bed or on the operating table, an avoidance of suffering that is not appreciable to those who have not experienced it.

"But we are very likely not to have the stretcher, and the patient is placed on a board. In that case I would try to arrange the board and patient exactly as I have described, believing that the double springs referred to would make it a more comfortable arrangement than can be constructed in a baggage car. Without the removal of a back of a seat, which might by some mishap be impossible, the backs of two may be raised horizontally, one seat intervening. By fastening them in this position, a stretcher may be laid on them, but the whole jarring of the car will be communicated to the patient and greatly add to his discomforts.

"In lieu of this another method suggests itself, but it involves the lifting and handling of the patient, the very thing to be avoided. It is this: Take the cushions out of three seats, the backs of which are arranged as first described. Lay a piece of board, small pole or anything that will reach across them

at either end for a support. Place the three cushions side by side on three supports, and with one cushion in addition the whole surface will be covered. On this bed two persons can lie quite comfortably for a long distance.

"Of course varying circumstances will suggest modifications of the methods proposed, but it seems to me a valuable thing to know that in a dense forest a common railroad car may in a few minutes be made a comfortable means of conveyance for one whose life is well nigh crushed out, especially when we remember that the sufferer may be yourself.

"To recapitulate; we have found our supposed patient on the ground, have lifted him directly upward a few inches, slipped the stretcher under him, carried him to the baggage car, and supporting the stretcher either by its leg or by placing its ends on boxes, or by suspending it with ropes, or still better, we may have carried him through the door of a passenger coach and placed the whole on the double cushions as described, then on arrival at his destination he has been carried to the operating table without having once been raised up, and one slight movement places him on the table and another in bed, every step being so conducted as to avoid to the last degree the injury that pain produces, and this branch of my subject is exhausted.

"But this problem occasionally presents itself in another and really embarrassing form. It may be necessary to move a patient whose leg has been broken, long before recovery is sufficient to permit its use in walking. We will suppose he gets about readily with crutches, but is unable to go up or down a stairway, cannot safely attempt even the steps of the front door. In that case select two men, one of whom is rather tall and the other of less height. Place your patient at the steps, the injured side turned a little forward so that the broken leg will swing clear in the future movements. The tall man taking his place at the side of the injury, the patient puts his arm around his neck, and the shorter man takes his place in like manner on the opposite side, both placing their arms around his waist. The tall man steps down one step when all



is ready. The injured leg swings clear, and the two men slightly aided by a springing effort of the patient, easily lift him sideways and plant him on his sound leg one step downward, and thus slowly and steadily, step by step, to the bottom. The same maneuver will take him up stairs, save that in going up the short man takes the advance. This method is entirely practical, but a strong-armed low back chair may be used satisfactorily. The patient being seated in it, one man steps in front and takes firm hold of one of the rungs; another seizes the back and by moving together, walk up or down stairs with ease and safety in either direction, one of the carriers moving backward. The chair has this further advantage: When it is necessary to place the cripple in a wagon, a light open-bodied spring being the best, he may be lifted into and out of it without leaving his seat until his arrival at the station, and in fact by no other means could he be so readily got into or off the car platform, as by carrying him up and down the steep, long steps by the same method. Either of the methods just described will answer, but the latter is no doubt most generally applicable, and when the dreaded adventure is over an astonished patient will thank you."

## CHAPTER II.

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### TEMPORARY TREATMENT IN CASES OF RAILWAY INJURY.

---

The preliminary treatment given at the time of the accident, and before the patient is removed to his home or to the hospital, is a service of the most vital importance.

The first thing for the surgeon to do is to see that the patient is placed in the most comfortable position possible. The next thing to be done is to make such investigation of the injuries as will inform him of the nature of the case, especially with reference to fractured bones, severe lacerations, or severed blood vessels that might cause excessive bleeding.

Should the surgeon find that any of the bones of either the upper or lower extremities have been fractured, it is his duty to at once apply a temporary dressing. This can be accomplished by the use of any material at hand, such as a piece of board, a walking cane, an umbrella, corn-stalks, or anything else that will give the required support, hold together the fragments of bone and prevent them from doing increased injury to the soft parts.

If the surgeon has provided himself, as he should do, with an "Emergency Case," spoken of in another chapter, he will have at hand the required splints to apply to the fractured limbs. Should he not have any splints and be unable to obtain anything at the place of the accident to serve the purpose, then he should, if the fracture be in the lower extremity, strap the in-

jured to the well limb; and if no bandages be at hand, the suspenders can be used, or a handkerchief, or strips torn from the patient's clothing. In cases of fracture of the ribs or sternum, relief may be afforded by simply grasping the shirt of the patient and drawing it tightly around the body and fastening it with a few pins as a temporary bandage. Should there be hæmorrhage, it must be arrested as speedily as possible. To this end let a compress or a rubber bandage be used. In the absence of these the writer has used to good purpose a pair of elastic suspenders.

Every surgeon should have with him at all times a hypodermic syringe and a small supply of sulphate of morphia in



such a form that it can be administered at any place. This should be given at all times before the patient is removed from the scene of the accident, as it will not only relieve pain and suffering, but will render valuable aid in reducing the shock and bringing about reaction. When an anesthetic is to be given the hypodermic injection of  $\frac{1}{4}$  grain of morphia combined with  $\frac{1}{60}$  grain of atropia will assist very much in producing anesthesia.

The next step in the treatment of the injured should be the administration of restoratives, especially when the injury has resulted in shock. A good cup of hot coffee, if it can be obtained, is perhaps as good a stimulant as can be given. In the absence of coffee a cup of hot water has been found to give good results as a restorative. In many



cases of railway injury, especially to passengers, the patients will be found to have all the alcoholic stimulants they should have before the arrival of the surgeon, for the reason that many persons in traveling have with them a flask containing some form of alcoholic stimulant and as soon as an accident occurs and parties are injured the first step taken by the attendants is to administer a stimulant. In many cases too much is given. A very excellent surgeon relates a case of a young lady who suffered *some* injury and *much* fright in a railway collision. Her fellow passengers promptly applied restoratives in the shape of whisky, brandy and wine. The officers of the road were advised of the accident, and they promptly sent their surgeon to the scene of the collision, with instruction to give the injured passenger the fullest benefit of his skill and best attention. When he arrived he found his patient in a state of "profound shock." He at once administered some alcoholic stimulant and continued to do so for some time, when it occurred to him that possibly the "profound shock" was simply a case of *profound intoxication*. Accordingly, he withheld his stimulants and in a short time the patient became conscious. As the intoxication passed away the symptoms of shock vanished. In the line of experience thus related the writer has met with many cases where the patient was suffering from intoxication far more than from shock.

A very safe and effective stimulant is made of spirits of ammonia aromatic, combined with sulphuric ether, tincture of digitalis and nux vomica. This is a mixture which every railway surgeon should have with him at all times.

The patient should always be kept as warm as possible. If the weather be cold, as is frequently the case, and there is no fire at hand, clothing should be collected from those present in such quantities as to protect the sufferer, that he may not die, as it sometimes happens, from the cold and shock combined. Care should be taken that the head remains low, and, as has been stated, the body in the most comfortable position possible.

The foregoing embrace the more important points in the temporary and preliminary treatment of those injured in railway accidents.

## CHAPTER III.

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### SHOCK IN RAILWAY INJURY.

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All the organs of the body are actuated by, and regulated through, the influence of the great nerve centers. Any impression made upon these nerve centers by serious injury causes, by reflex action, a degree of functional disorders which is characterized by a general depression of the powers of life, known to surgical authorities as *Shock*.

When the functions of the various organs are harmoniously and regularly performed health prevails, but when they are disturbed by injury the condition of health is changed to that of disease, however sudden the change may be. If the injury be of such a nature as to produce a marked derangement in the functions of the local nerves, the reflex action may so depress the powers of life as to result in what is termed collapse or shock. If this condition immediately follows the injury it is designated as Primary Shock; but when it comes after the lapse of several hours, or of several days as some authorities claim it may do, it is then known as Insidious or Secondary Shock.

This division may appear to be arbitrary, as it is frequently extremely difficult to make a clear distinction between the Primary and Secondary symptoms. In both conditions, however, there is the common feature of depression, the degree of which depends upon the severity of the injury.

The railway surgeon has not so much to do with the pri-

mary as with the secondary forms of shock. In the lighter forms of injury the shock is not so great, usually, as in the more serious, such as the crushing of a leg or an arm by the heavy machinery of a railway train. With the exception of burns or scalds railway injuries are attended with greater fatality than are the wounds received in any other way. Surgeons generally concede that the cause of the unusual mortality following injuries of this character is from the fact that in a majority of cases the shock, in intensity, is out of all proportion to the extent of the injury sustained. This condition is frequently the result of the great mental excitement or fright incident to accident, and, therefore, the mental condition of the patient should be carefully considered by the railway surgeon.

Persons injured while in a state of intoxication seldom suffer much from shock.

In relation to the subject under consideration the following extract from an able paper read by Dr. C. B. Higgins at a meeting of the surgeons of the Wabash, St. Louis & Pacific Railway, in Fort Wayne, Ind., June 4, 1883, is of great value. Says Dr. Higgins :

"Most writers on this subject fail to give sufficient prominence to physical influences in considering its etiology. In my opinion mental impressions are the chief, if not sole, elements to be considered in connection with the cause of the intense degree of shock we so often observe following railway accidents.

"Not long ago I was called upon to visit a young man who had fallen in front of his engine and received a crushed leg. There was no other injury, yet he died in less than three hours after the receipt of the injury, of shock. I am confident that in his case death would have resulted had there been no bodily injury. The terror induced by the contemplation of the consequences of the fall was sufficient in his case to produce a state of mental depression from which it was impossible to recover. This young man was a perfect specimen of physical manhood—æt. 25 years, of sanguine temperament and guilty of no excesses.

"Shortly after the occurrence just reported I was summoned to see an old man, æt. 72 years, who, while in an oblivious state of intoxication, had been run down by an engine, and received a wound to all appearances as serious as the one occurring in the case previously mentioned. In the latter case there was no evidence of shock, and the patient was so thoroughly under the influence of liquor, that the leg was amputated in twenty minutes after the infliction of the wound, without the administration of any other anesthetic. The patient made a rapid and perfect recovery.

"It is not my wish to have it understood that I have drawn my conclusions from the observation of the two cases reported, for I could cite a number, all tending in the same direction; in fact, all my experience as a surgeon leads to the conviction that when a wound is inflicted without warning, the attending shock is generally of little consequence. I have never witnessed an extreme degree of shock occurring in a person who had been injured while in a state of intoxication. How often do we hear the remark in reference to an intoxicated person who has survived some serious accident, 'had he been sober it would have killed him.' I will relate my experience in another case to further strengthen my position. An insane spinster, æt. 38 years, eluded her attendants and threw herself in front of a moving train, receiving injuries which necessitated the amputation of both legs. In her case there was no hemorrhage and no shock. When freed from the influence of the anesthetic, after the completion of the operation, she was found to be in possession of her right mind, and has so remained ever since. She speedily recovered from the effects of the accident without the occurrence of an unfavorable symptom."

From the report of the above cases, and the personal observation of many others in the experience of the author, it is believed that mental depression, the sequence of the terror caused by the accident, is one of the elements entering into the condition of shock. Prof. D. Hays Agnew, in his work on Surgery, says: "The intensity of shock depends on a variety of conditions." Enumerating these conditions under the head

of "Constitutional Peculiarities, Mental and Physical," he says: "A timid or cowardly person exposed to some sudden accident will, even though the bodily injury be slight, suffer a more serious prostration than one who is fearless and indifferent to danger." Cases are reported on good authority of persons, who, upon entering an amphitheatre in a hospital to submit to a surgical operation, have fainted and died. Sir Astley Cooper mentions the instance of a strong, vigorous man, who had been suffering some days from an abscess of the finger, caused by a splinter of wood. An incision was made to give vent to the matter, when the patient raised himself from the bed in a convulsive manner and immediately expired. Such results can only be explained on the theory of some individual peculiarity or idiosyncrasy of organization. On the other hand, we find a class of cases of persons of a cold, phlegmatic temperament, with strong nerves and firm, defiant muscles, who endure all forms of injury and mutilation without an expression of pain, or any depression of the vital forces. And so it is in some cases there may be a crushed leg or arm with but a slight depression of the general vitality. Again, if the body be included in the injury, as it frequently happens in railroad and machinery accidents, the shock will be much greater. There can be no question, however, that many cases of instantaneous death are the immediate result of a general shock without any serious lesion to any one organ of the body.

#### THE REMOTE EFFECTS OF SHOCK.

This question is of great importance to the railroad surgeon and should be very carefully considered. Out of the great number of persons injured on our railroads many will present themselves to the surgeon after the lapse of months, and even years after the injury was received and complain of the effects of the shock. In no small number of these cases it will be found that the object is to secure from the surgeon an opinion which may serve them in a suit for damages against the company in whose services they were when the injury was inflicted.

It cannot be denied that in some cases lingering effects of the shock may be discovered, but in most of the cases, especially where heavy damages are sought for, it will be easily discovered by the surgeon that the patient is a *malingeringer*. Surgeons, therefore, should be very careful in giving an opinion in such cases, as it will generally be found that the symptoms and sequences complained of are out of all proportion to the injury originally sustained.

#### PROGNOSIS.

Should the pulse become fuller and increase in force and regularity, the pallor leave the face and the respirations be performed with greater freedom and fullness, with an occasional deep sigh, the indications point to a favorable termination, especially should the temperature of the skin be increased, and the patient manifest a desire to change his position by turning on his side, or by drawing up his limbs. Any desire or effort on the part of the patient to change his position may fairly be considered a favorable omen, as it indicates a degree of muscular energy. The supine position is indicative of muscular weakness and when it is maintained for any great length of time denotes extreme debility, and must be regarded as unfavorable. The longer reaction is delayed the more unsatisfactory the case will be and correspondingly greater the danger of a fatal termination. Dr. Agnew forcibly observes that "every hour after twenty-four tells against the patient."

#### TREATMENT.

In many cases where the shock is slight, but little treatment will be required. The patient should be removed at once from the scene of the accident, especially if likely to be surrounded by a curious crowd of spectators, who will make all manner of remarks in reference to the serious conditions of his case, which will have a tendency to add greatly to his depression and



correspondingly lessen the chances of his recovery. Dr. Higgins, in relation to the treatment of shock, says. "Entertaining the views I do in relation to the cause of shock, my treatment would naturally be directed toward securing a state of mind as little influenced by fright as possible." Prof. John C. Dalton, in his work on Physiology, when speaking of shock, says: "It is only after nervous irritability has been restored by repose that voluntary motion and sensation are re-established. It would be well for us in our treatment of shock, such as we meet in railway practice, to keep this statement well in the foreground and govern our efforts to secure reaction accordingly. Many patients have been thrown into a condition of more profound collapse by the too vigorous application of so-called restoratives, who if left to themselves in seclusion and quietude, would have recovered. \* \* \* The patient should be conveyed to a well-ventilated apartment, and only such persons admitted to the room as may be necessary to properly care for him. The surgeon and attendants should make every effort to conceal their anxiety, for the apparently lifeless patient is often possessed of sufficient vitality to comprehend his surroundings. It will generally be found that the victim has been liberally dosed with whisky or brandy before the arrival of the surgeon. I wish here to express my unqualified approval of the position taken by the late Dr. John T. Hodgen, at the meeting of the American Medical Association in 1873, in reference to the administration of alcoholic stimulants in the treatment of shock. When the stomach is sufficiently active in these cases (which is not often) to allow of their being appropriated, they are of no good. It frequently happens that when reaction is secured, the stomach is full of the alcohol and the assimilative function being re-established, the stimulant is rapidly appropriated and we soon have a condition to contend with which is as dangerous and fully as difficult to overcome as the original trouble. As before remarked, the chief object in the treatment of shock is to secure repose. This is best accomplished by the hypodermic administration of morphia, and in these cases

it will be found necessary to use more than the ordinary dose to obtain the desired effect. If from any cause morphine should be contra-indicated, ether may be administered hypodermically in drachm doses, frequently repeated. In addition to this treatment attempts should be made to restore the temperature of the body to the normal standard by the application of dry heat. These applications should be made with as little disturbance to the patient as possible. The practice so frequently resorted to of applying cloths wrung out of hot liquids of various kinds, owing to the rapid evaporation, has an effect just the opposite from that intended. The use of mustard plasters, friction, electricity, etc., I shall mention only to disapprove of, as the excitement attending their application overbalances any good they may accomplish.

"If we fail to secure reaction by absolute quiet the judicious administration of restoratives and the application of heat in the proper manner, we will certainly not add to our chances of success by resorting to the numerous other applications recommended by various authorities as useful in this condition. I will close this article with a few words in relation to the time for operation in cases of shock. If the patient shows signs by increased strength of pulse and otherwise that reaction is being established, the sooner the operation is performed the better, for the administration of the anesthetic has a very decidedly beneficial influence in promoting the condition of mind which we have been directing our treatment to secure. I think a surgeon, unless he has so firmly established his reputation as to be out of the reach of criticism, would be very foolish to begin an important operation upon a patient so thoroughly under the influence of shock as to be insensible to pain and oblivious to all surroundings, and consequently in no need of an anesthetic."

Having quoted at length from this able paper of Dr. Higgins it only remains to be said that his remarks on alcoholic stimulants are especially endorsed. Many patients are so overdosed with this pernicious remedy that the effect really is of a depressive rather than of a stimulative character. A cup of



hot coffee or tea, with the application of dry heat, and friction when it can be employed without giving pain, will aid greatly in bringing about reaction and is much better than the too liberal administration of whisky. The author has found the following very valuable in these cases :

R <sub>x</sub>	Tr. Digitalis,	-	-	-	-	-	5 j.
	Ether Sulph.,	-	-	-	-	-	5 iij.
	Fl. Ext. Nux Vomica,	-	-	-	-	-	5 ss.
	Spts. Frumenti,	-	-	-	-	-	5 jss.
	Glycerine,	-	-	-	-	-	5 j.
	Aq. Destil.,	-	-	-	-	-	5 j.

Sig.—Two teaspoonfuls every half hour. At the same time give hypodermically :

R <sub>x</sub>	Morphia Sulph.,	-	-	-	-	gs. ss.
	Atropia Sulph.,	-	-	-	-	gs. $\frac{1}{60}$ .

This will tend to allay the pain, calm the mind and thus aid in bringing about reaction.

The question in regard to operating during the continuance of the shock, and before reaction is established, is one of great importance to the railway surgeon. Frequently the patient and friends become over-anxious that something shall be done, and if the surgeon is not cool-headed and careful he will yield to the influences surrounding him and operate too soon.

When the pulse is coming up, the pallor is leaving the face, the skin becoming warm, the heart beating regularly and the respirations free, deep and full, then should the operation be made and not before. If, however, the surface remains cool the pulse feeble, the action of the heart weak and rapid, and the respiration frequent and irregular, then the operation should be delayed. Far better is it to wait than to have the patient die on the table, or soon after the operation has been completed. The surgeon *must* exercise his own good judgment in these cases, and be not in too great haste to make "a capital operation," while his patient is yet under the effect of shock. In some cases where the shock is the result of mental depression, and where there is great fear, the administration of an anesthetic will render great service in establishing reaction

and in such cases the surgeon would be justified in operating without delay.

When a patient has greatly suffered from prolonged shock and an operation has been made, much care must be taken, afterwards, that he remain quiet. Let the artificial heat be maintained and give the digitalis, ether and nux vomica mixture until the heart is able to circulate the blood and the nerves are restored to their normal condition, or nearly so, at least. Hot beef tea should be administered with coffee, milk and tea; and above all things let no one be admitted to the room except those entrusted with the care and comfort of the patient. On the grave-stone of many a poor fellow might be carved the inscription: "Hurt in a railway accident and then *talked to death.*"

## CHAPTER IV.

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### ANESTHETICS.

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The railroad surgeon should at all times be prepared to administer an anesthetic when it becomes necessary and proper to do so. In considering this subject we are at the outset confronted with the question: Which of the two well known agents, ether or chloroform, is the better? Much has been said and written upon this question; many able surgeons favoring chloroform, while others, with equal skill and experience, are found to entirely discard it. In a paper read before a meeting of the surgeons of the Chicago and Atlantic Railway at Huntington, Ind., February 8, 1887, Dr. B. R. Freeman, of Decatur, Ind., contributed much interesting and valuable information on the subject. Discussing the question historically, Dr. Freeman says: "The discovery of chloroform as an anesthetic was made soon after the discovery of sulphuric ether in 1846, and was received with great enthusiasm as a substitute for the latter. Its power, certainty, rapidity of action, convenience, absence of unpleasant effects to the patient, made it at once an almost universal substitute. The dangers connected with its use, however, soon manifested themselves, and many returned to the use of ether. In Boston ether was never entirely abandoned as it was elsewhere, and the few that discontinued it returned to its use almost immediately. In Great Britain chloroform obtained such a footing as to almost entirely supplant the use of ether for some fifteen or twenty years. Some few

of the profession refused to accept the change, and continued to use ether, claiming even at that early day that it was safer than chloroform. But the increase in the number of deaths from chloroform began to be observed, and occasioned comment and controversy, the result of which was the general abandonment of chloroform and the return to the use of ether as an anesthetic. To-day ether has the preference in this country and Europe over all other anesthetics used, and this preference has been rapidly growing for fifteen years. Many medical societies have placed themselves on record as being directly opposed to the use of chloroform, considering it an unsafe anesthetic. The number of deaths from chloroform, recorded up to this time, is about six hundred, and there are, necessarily, many unrecorded cases. The cause of death seems to be enveloped in mystery in many cases; the many theories advanced seem not to be fully satisfactory. If the cause were fully understood we would be better enabled to understand how to prevent the calamity. Chloroform is the most potent and dangerous of anesthetics, and is the only one by which death may occur at any stage by inhalation; unlike ether, it kills so suddenly that neither care nor skill can guard against a fatal result. It has been claimed by some of the advocates of chloroform that the majority of deaths from its use were caused by pushing the anesthetic too far, but investigation proves that such certainly is not the case, as far the larger per cent of deaths occur from administering it in minor operations. The Chloroform Committee appointed in 1878 by the College of Physicians and Surgeons of London investigated one hundred and nine cases of death from chloroform, and found eighty-eight deaths from minor operations, nine from capital operations, six from reduction of dislocations, four from delirium tremens, and two from natural labor. Certainly no surgeon would put a patient so profoundly under its influence as to endanger life to perform a minor operation. The quantity of chloroform necessary to produce death is variable; as small a quantity as seventy-five to one hundred drops has caused death. Dr. Taylor, of London, in his work on poisons, on

pages 621 and 622, states that fatal cases have been proportionately much more numerous from the use of chloroform vapor than sulphuric ether—even the impure ether used in England. After relating a number of fatal cases in which as small a quantity as a drachm of chloroform in vapor produced death suddenly, he remarks it is not necessary that the theory of fatty or flabby heart as the cause of death be brought forward to explain the fatal result—they are simply cases of poisoning. He then relates that the death of a hearty man took place on the operating table in a London hospital, in three minutes, from two drachms of chloroform given in vapor. The gentleman who administered it had given it previously to three or four hundred patients, and it was candidly admitted on this occasion that the body was quite healthy. In 1872, Dr. Thomas Jones, who was for eighteen years administrator of anesthetics in St. George's Hospital, London, wrote: "I have administered chloroform in more than six thousand cases. I confess experience has taught me that chloroform, even when carefully administered, is more dangerous than is generally supposed. If I was unfortunately compelled to take an anesthetic, nothing could induce me to take chloroform." In 1880 Mr. Osborn, chloroformist to St. Thomas' Hospital, London, states in his report on anesthetics that sulphuric ether is given in all possible cases because of its undoubted greater safety. In 1881 it was declared that there had been an average of one death every month since chloroform was introduced into Europe. Such deplorable results should be considered sincerely by surgeons before they add to the ordinary and unavoidable risks of an operation, of which no sagacity can foreknow, and no skill prevent. These are the reasons why some very eminent and conscientious surgeons have given up the use of chloroform. Except in rare cases, and so long as it continues to be used, there will always be a certain distinct mortality arising from its use, that no human skill, in applying it, can divest of its dangers. The advocates of chloroform, in discussing this question, are apt to point with pride to Prof. Gross as having used it continually for almost half a century, without a single death,

but they fail to state that in the latter years of his life he abandoned it for ether. I copy from an article written by Dr. O. H. Allis, of Philadelphia, personal recollections of Prof. I. D. Gross. He says: "Prof. Gross' early preference for chloroform never left him, although in the latter years of his life he relied entirely upon ether. I do not think that the change was brought from fear, lest casualties which had befallen Simpson, Syme and other distinguished English surgeons might mar his brilliant record. He felt that it was slower and, therefore, safer, and he yielded his individual preference for the good of others. The main reason why he never had an accident was always having a faithful reliable assistant to give the anesthetic, and he kept him when he got one. This is best exemplified in Dr. Hern who enlisted in his service in 1870 and continued to assist him until the close of his life. How strangely does this true estimate of a surgeon's responsibility contrast with many physicians who administer the anesthetic, and at the critical moment, when the operation needs their closest attention, transfer the anesthetic to a student, nurse or an attendant of the family. It is usually regarded as good medical ethics for a surgeon to give the one who has brought him the case the place of honor at the time of the operation, but such was not the practice with Prof. Gross. He had trusty assistants for the places of danger, and he placed the life of the patient upon a higher level than the platitudes of medical ethics. I will now give Dr. Hern's views, the gentleman who administered anesthetics for Dr. Gross for fourteen years: "I gave chloroform for many years and never had an accident, but I cannot recommend it. My instructor was the late Prof. Gross, who never had a death from it; but it has been said by a distinguished author that the man who persists in the use of chloroform in the face of all the evidence we have against it is beyond the pale of argument. I am not afraid to use it, but do not use it because ether answers as well and is much safer." This extract is from a lecture delivered at the Philadelphia Hospital by W. Joseph Weam, February 1, 1886.

In what class of cases can chloroform be employed with



safety? I would limit the use of this most potent of all anesthetics to very young children, to puerperal eclampsy, or to females during delivery when rapidity of dilatation of the os uteri is absolutely necessary to save the mother's life. In some rare cases of painful operations when, after continued efforts, no complete insensibility can be produced by ether, I would feel justified in the use of a small portion of chloroform. By carefully studying the reports of investigations of deaths from this agent they will certainly satisfy the most skeptical that no amount of care or precaution will prevent, in certain cases, a fatal result, yet physicians will continue the use of it on account of its pleasant effects, odor and rapidity of action. In the recent admirable work on surgery by Erichson, page 43, he discusses this question: "Does anesthetics influence the rate of mortality after operations," and concludes by stating: "I am inclined to believe that the rate of mortality has increased since the use of anesthetics in operative surgery. I cannot but think chloroform does lessen the prospect of recovery in certain states of the system." There have been six hundred deaths from chloroform faithfully recorded and reported up to 1884. Most of these occurred in the hands of experienced surgeons, and many of them in large hospitals, where every appliance was to be had, and all the known means employed to prevent death. Such being the case, can any physician say truthfully that chloroform is not a potent and dangerous anesthetic.

But what can be said of sulphuric ether? It is not altogether free from danger, but it always gives warning before it causes the death of the patient. Why is it that sulphuric ether has been displacing chloroform for the last fifteen years? Is it from the fact that experience has taught the profession that it is the safest anesthetic known? What does Prof. Ringer in his therapeutics edition of 1878, page 344, say? "Ether, for many years, was preceded in this country (England) by chloroform as a general anesthetic. At the present time there is much contention as to the relative merits of the two, but sulphuric ether is rapidly taking the place of chloroform. Sul-

phuric ether is undoubtedly the most perfect anesthetic we possess for use by physicians and the general surgeon. The proofs of its safety are full and complete.

In the city of Philadelphia it has been used since introduction in 1846 to 1884. In these thirty-eight years, at least from three to five times a day it has been employed by nine hundred and sixty-seven regular physicians. These 13,890 days multiplied by three make 41,670 administrations without a single primary death, and only one secondary.

Prof. Andrews, of Chicago, collected from different American statistics, 117,078 cases of administration of chloroform with 43 deaths, affording a mortality of one death to 2,723 administrations, and 92,815 administrations of ether with four deaths, being one death to 23,204 administrations. A careful examination was conducted by the Royal Medical Chirurgical Society of London, 1878, into the merits of ether and chloroform by means of the sphygmograph, testing the effects of the two anesthetics on the heart's action and the influence on the contractions. The report states the essential difference between the action of chloroform and ether is found in the effect produced upon the heart. The first operation of both agents is to stimulate the heart and augment the contractions. After this chloroform depresses the heart's action, whereas ether appears to continue its stimulating influence upon the muscular movement of that organ.

These experiments were made upon eight patients of diminished health and vitality, yet the most perfect anesthesia could be invoked under the influence of ether with an absolute stimulating effect on the circulation, and that insensibility could be maintained for a considerable time. Yet there was no material alteration in the pulse writing and the most perfect sense of security was established. It is, therefore, established that while chloroform exerts a depressing influence on the heart, ether exerts a stimulating one, and that chloroform is the more dangerous. I will now conclude the statistics with regard to ether by appending the report of a committee of the Boston Society of Medical Improvement on the alleged



dangers which accompany the inhalation of sulphuric ether. I would be glad to give the whole of this able pamphlet, but must be content to give the conclusions which accompany it.

The general conclusions arrived at by the committee may be summed up as follows:

1. The ultimate effects of all anesthetics show that they are depressing agents. This is indicated both by the symptoms and results of experiments. No anesthetic should therefore be used carelessly, nor can it be administered without risk by an incompetent person.

2. It is now widely conceded both in this country and in Europe that sulphuric ether is safer than any other known anesthetic, and this conviction is rapidly gaining ground.

3. Proper precautions being taken, sulphuric ether will produce entire insensibility in all cases, and no anesthetic requires so few precautions in its use.

4. There is no recorded case of death known to the committee which cannot be explained on some other ground equally plausible, or in which, if it were possible to repeat the experiment, insensibility could have been produced and death avoided. This cannot be said of chloroform.

5. In view of all these facts the use of ether in anesthetics to the extent which its bulk will permit ought to be obligatory at least in a moral point of view.

6. The advantages of chloroform are exclusively those of convenience. Its dangers are not averted by its admixture with sulphuric ether in any proportions; the combination of these two agents cannot be too strongly denounced as a treacherous and dangerous compound. Chloric ether being a solution of chloroform in alcohol, merits the same condemnation.

But whatever anesthetic is employed, nothing obviates the necessity of care in the administration, and above all, not to give more of the agent than is absolutely necessary to keep the patient from pain; not one drop more, for, like all potent medicines we employ, an excessive dose is sure to kill, and unless we have before gauged the patient's powers, let caution be our guide in the administration. In our anxiety to see the

various steps of an operation we must not saturate the sponge, or lean over the patient and by accident suffocate him. It is, unfortunately, too much the practice to entrust the inhaling apparatus to some inexperienced hand, one who perhaps never before administered an anesthetic, and even in some of our hospitals it is the practice to give this place to the youngest assistant surgeon or dresser. It has been well said by Perrine that we shall render a veritable service if we popularize the idea that anesthetics should be observed and studied at the hospital with as much care as any other subject of practical medicine. The administrator should be experienced. Several hospital committees have acted wisely in appointing a person especially for that purpose, which is not of less value to the operating surgeon than for the benefit of the patients. One who administers in any case should confine himself exclusively to that task, and should continuously mark the symptoms.

What are the symptoms of danger? The failure of the pulse, irregularity of the respirations, a cyanotic or blanched countenance are all indications of danger and require prompt treatment; and the person administering the anesthetic should be able to interpret these signs correctly without drawing the attention of the operating surgeon from his work, for it is very embarrassing for the operator to have to divide his attention between the operation and the condition of his patient. You should proceed steadily, but cautiously, to the end in view. Make haste slowly; with boldness tempered by wisdom you carry your patient down into the dark valley which borders on death. You drown human agonies in the waters of Lethe and triumph in the crowning glory of your art."

We have given the entire article of Dr. Freeman, as it presents the statistics and reports of the committee appointed by the College of Physicians and Surgeons of London, in 1878. The administration of  $\frac{1}{4}$  grain of morphia sulph., with the  $\frac{1}{60}$  grain of atropia sulph., before giving ether, will be found very valuable, and the author is of the opinion that it will aid in bringing about reaction. This admixture should be given im-

mediately, even before the patient is removed to his home or hospital, for the purpose of relieving pain and bringing about reaction.

Dr. C. N. Rockwell, of Taylorsville, Ill., in a paper read at the meeting of surgeons of the Wabash, St. Louis and Pacific Railway at Fort Wayne, Ind., June 4, 1884, and published in the *Fort Wayne Journal of the Medical Sciences*, says: "I commend the treatment by the use of  $\frac{1}{120}$  grain of atropine given by hypodermic injection, and if necessary repeat the dose in from ten to fifteen minutes." He also recommends the use of morphia. In this way he claims he is enabled to induce rapid anesthesia. Besides the anesthetics in common use



(ether and chloroform) we have also nitrous oxide, bromide of ethyl, cocaine, and the various mixtures of the different agents named. The surgeon is desirous of knowing the best and safest to use. We unhesitatingly state that ether should be used in all cases, it having been demonstrated to be much safer and just as certain to produce complete anesthesia as chloroform. There have been many instruments invented and are now in use for the administration of ether, but the writer has abandoned all and uses only a good napkin or large towel folded, so as to hold the ether, sometimes in the

shape of a cone, with a sponge in it saturated with ether. Always begin the administration of it slowly so that the mucous membrane will become accustomed to the presence of the ether without producing the irritating cough so often observed.

## CHAPTER V.

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### LACERATED WOUNDS.

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Lacerated wounds are frequently met with in cases of railway injuries received by those who are employed either in the manufacture of engines or cars, or by those employed as train men or switch men. Lacerated wounds are frequently complicated with contusion. Without stopping to define the different kinds of wounds it is only necessary to say that in lacerated wounds we find a tearing of the tissues, and usually some contusion; especially, as already suggested, among the train men. Among shop men, lacerated wounds are frequently met with without any contusion whatever. In a lacerated wound but little hemorrhage will occur. In fact, as a rule there is scarcely any, even though large arteries have been torn. Prof. Ashurst in his work on surgery says: "There is usually under these circumstances comparatively little or no hemorrhage, as in Cheselden's well known case of avulsion of the whole upper extremity, but occasionally the bleeding is very profuse and proves directly or indirectly fatal."

It is always best to examine at once to ascertain whether there is any bleeding. In many cases the laceration is very extensive and the soft parts are torn into shreds. The diagnosis should be carefully made by the surgeon, and to accomplish this it may be necessary to give an anesthetic. The surgeon should at all times strive to avoid giving any unnecessary pain, consequently in making any examination of an

injury if it cannot be made without giving pain an anesthetic should be administered. The days of cruelty and brutality upon the part of the surgeon are past. Before the discovery of a safe and reliable anesthetic it no doubt did require a surgeon to at least appear hard hearted and unmoved by the cries and agonies of his patient. In the very nature of the case it must have caused a certain degree of what the laity call "hard heartedness," but thanks to Sir James Y. Simpson and others in bringing before the profession several good reliable anesthetics the surgeon need not now torture his patients while making a protracted examination of the injuries if he will only take the time to administer one of them. In making an examination the first important point is to ascertain the extent of the wound, and what tissues and vessels are invaded; especially is this important in regard to nerves and blood vessels. Should important arteries be torn we may have gangrene resulting from insufficient blood supply; or if the nerves have suffered from the laceration we may have paralysis. It is necessary that all of these conditions be observed at the first examination for the reason that it will have a great bearing on the treatment to be adopted, and enable the surgeon to point out the danger there is in the case and the probable termination, whether favorable or otherwise. Railway surgeons are viewed by some as the hired servants of their company, bound in all cases to do as the company requires and to protect its interest at all hazards, even to that of being biased on the witness stand in its favor. Under these circumstances the surgeon should always be on the alert, examine carefully every case and know as fully as it is possible the true nature and extent of the injury in every case he is called upon to treat.

#### THE TREATMENT OF LACERATED WOUNDS.

The first indication for treatment of these wounds is to arrest the hemorrhage, if there should be any, but do not use any astringent, or so called styptic. The writer has always succeeded with the use of hot water unless the hemorrhage



was from a severed artery, in which case ligation is resorted to. We have seen great mischief done by the use of Mouselle's solution, and the different forms of styptic cotton.

The second indication is the cleansing of the wound, and this is the most important part of the treatment. See that all foreign substances are removed. The following is a case in point: A switch man had a small iron bolt forced through the soft part of the forearm. The wound was not thought to be at all serious but continued to grow worse, until it was thought advisable by those in charge of the case to amputate the arm. When called upon to perform the operation the author made a careful examination of the wound and found that a portion of the overcoat, coat and shirt had been forced into the arm at the time of the accident and allowed to remain. Its presence had caused the terrible inflammation and consequent suppuration. Had this wound been thoroughly cleansed at the time of the first dressing it would have healed in a few days and the patient would have been able to resume his labor instead of being confined to his room for several weeks and requiring a still longer time to regain his health.

Always cleanse the wounds thoroughly and do not neglect this highly important part of the treatment. Many of the older surgeons taught that all lacerated wounds healed only by granulation, but modern surgery has taught that suppuration need not necessarily occur. If the parts are properly cleansed and the flaps, shreds of muscle, and all the torn tissues are re-adjusted and dressed antiseptically, union will frequently take place without suppuration. When the laceration is very extensive it will always be well to employ a good drainage tube. This is very important as it enables the serum to escape easily. Some surgeons do not close the wounds but it is thought better practice to trim all contused parts, then close and adjust the wound. As already suggested it may be proper and advisable to use a drainage tube.

In all these cases the antiseptic mode of treatment is recommended with the assurance of the writer that during a number of years of experience with this mode of treatment he has

been able to prevent any extensive suppuration. The following case is given in illustration: August 28, 1886, a Mr. C., æt. about 45 years, employed in the car shops of the Pennsylvania company at Fort Wayne, Ind., had the misfortune to have his hand caught in a half inch planer, the hand being carried into the rollers and the arm drawn up to the shoulder before the machinery could be stopped. The parts were fearfully torn and in fact the muscles and integuments were drawn down like a coat sleeve below the elbow. He was removed to the St. Joseph Hospital and preparations were made to amputate the arm at the shoulder joint, but when placed under the influence of an anesthetic so that a careful examination could be made it was found that no bones were broken and that the arteries were not injured. Accordingly an effort to save the limb was determined upon. The parts were first thoroughly cleansed by the use of a solution of the bichloride of mercury—one part to two thousand; then all the torn tissues were re-adjusted as nearly as possible and dressed with the antiseptic gauze and iodoform. The result was that the muscles, which had been held in position with many catgut sutures, united without any suppuration; but the integuments, which had been entirely devitalized, became dry and hard and had to be removed. Underneath this there was a granulating surface which required a long time to entirely heal, but the arm was saved and is a useful member.

Doctor J. J. Buchannan, one of the surgeons of the Pennsylvania company, read a most valuable paper on this subject at a meeting of the surgeons of that company held at Alliance, Ohio, in May, 1885, which, on account of its great value, we reproduce. The Doctor says:

"The subject to which I ask your attention to-day is "The Treatment of Wounds of the Soft Parts," a subject which is of especial importance in the domain of railroad surgery. I have little doubt that most of the statements which I shall make will meet your approval, not only because they are essentially the principles which are laid down by the most esteemed of modern writers on surgery, but also, and chiefly, because they

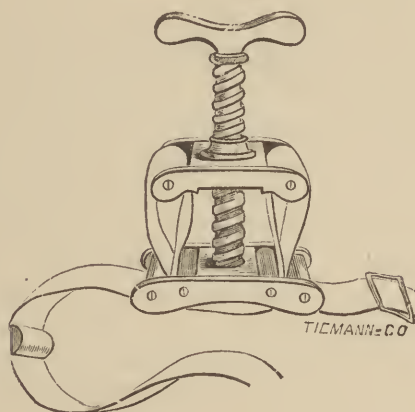


coincide with the teaching of your own practical experience. There are, however, other principles, based on a comparatively modern theory, which have by no means met with such general acceptance. These latter principles, while they do not conflict with the generally received precepts of wound-treatment, require for their adoption certain precautions not formerly employed. Whether these new principles shall hereafter receive the recognition of the profession generally, remains to be seen. I can only say that the experience which I have had in their practical application has convinced me, at least, of their soundness. When the surgeon approaches a wound in which the cut surfaces can be exactly applied to those from which they were separated, it becomes his duty, under ordinary circumstances, to endeavor to secure primary union. If, however, the wound be of such a nature that this accurate apposition cannot be gained; but if the surfaces can be so approximated that there is a reasonable expectation that the union may be attained by the organization of the interposed plastic lymph and clotted blood, he should endeavor to secure union by this method of healing. If, in the third place, the character of the wound be such as to preclude the hope of healing except by granulation tissue, the aim should be to promote the growth of granulation and reduce to a minimum the subsequent suppuration. Now, what are the circumstances which ordinarily conspire to prevent these favorable results? In other words, what are the common wound-disturbances? In the first place, the surfaces may be separated by the interposition of foreign bodies, such as sand or glass, or by a blood-clot too extensive to become organized. Secondly: The irritation caused by the vulnerating body may be so great that a large quantity of serum is poured out during the first twenty-four hours, with the result of widely separating the wounded surfaces. Thirdly: During the period of healing, the necessary rest may not be secured for the wounded part and the motion of the surfaces upon each other may break up the adhesions and prevent union. Fourthly: The vitality of the wounded surfaces may be destroyed by the accidental application of

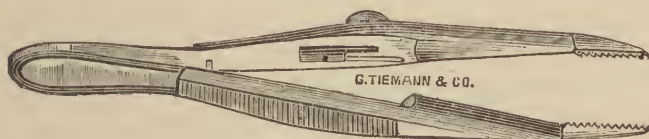
strong chemicals, such as acids or alkalies, or by the application of the actual cautery either accidentally or for the purpose of checking hemorrhage. Fifthly: The entrance and multiplication of micro-organisms or lower forms of life, may cause decomposition of the wound-secretions and the production of profuse suppuration. Now the first of these wound-disturbances all will concede—the interposition of blood and foreign bodies, collections of serous discharge, lack of rest for the part and chemical irritants; but the fifth, the irritation caused by bacteria and micrococci, there are many who deny.

“To present a complete and logical exposition, which I believe can be done, of the truth of the statement that the lower forms of life are among the most frequent causes of failure to secure primary union and of excessive suppuration would require many papers of greater extent than the present one. It will therefore be necessary for me to assume, what I believe to be the fact, that micro-organisms are invariably the cause of decomposition in wound-secretions and that such decomposition is, in most cases, the cause of suppuration. Having clearly recognized the chief disturbances which may unite to prevent the safe and speedy healing of wounds, what general principles can be deduced for their treatment? Stoppage of hemorrhage; provision, if necessary, for drainage of blood and serum; destruction of micro-organisms already present, and prevention of their future access; accuracy of apposition; rest for the part, such are the great principles which should govern the treatment of wounds. Now, the practical application of these principles, as they are embodied in the various steps of wound-dressing, is the matter to which we must direct our attention. When the surgeon approaches a wound from which an active hemorrhage is taking place, his first duty, obviously, is to check the bleeding. Temporary hæmostasis, then, is the first indication. If the hemorrhage be profuse, he may thrust his fingers into the wound and make compression of the bleeding point. He may make digital pressure over the course of the vessel so as to intercept the flow of blood to the wound. If the injury be of an extremity, he may apply

the ordinary field tourniquet, a few turns of the elastic bandage or even the Spanish windlass. I speak now only of temporary



necessity, when the flow of blood must be checked at any hazard. As soon as the emergency has been met and the hemorrhage checked, either by the fingers in the wound or by compression, in some form, of the trunk of the vessel, attention must be paid to securing the injured vessel in the wound, either by the artery forceps or the acupressure pin, the forceps



being either allowed to remain or followed by torsion of the vessel or application of a ligature. As soon as the vessel has been secured in the wound by forceps, ligature, torsion or acupressure, the tourniquet or other constricting apparatus, if any have been applied, should be removed, for it cannot be too strongly insisted upon that the limb which is encircled by any constricting band is in imminent peril. This much having been done on the spur of the moment for the safety of the patient's life, which we have supposed to be in more or

less jeopardy from loss of blood, the surgeon is now at liberty to proceed with more deliberation to lay his plans for the safe and speedy repair of the wound.

"In all his future manipulations he should constantly bear in mind the admonition of that great German surgeon, Esmarch, who said: 'Do no harm.' In dressing the wound, the attendant may do it actual and positive harm by introducing on his fingers, his instruments or his sponges the germs of the lower forms of life, which, finding in its secretions a favorable medium for their development, may cause decomposition with its attendant evils. If an operation be deemed necessary prior to the dressing of the wound, each of the instruments required, even to the needles, should be carefully cleansed and disinfected. The latter process is best accomplished by complete immersion in a 5% solution of carbolic acid. A solution of corrosive sublimate cannot be used for this purpose on account of its corroding action on steel. Sponges have been entirely discarded by many surgeons on account of the great difficulty of keeping them pure. They are the most dangerous objects which are brought in contact with wounded surfaces and, whether new or old, the operator should be personally cognizant of their complete disinfection.

"Absorbent cotton, however, is a much safer material, is little or no more expensive and answers almost as well.

"One word about absorbent cotton. Most of that marked carbolated is entirely innocent of carbolic acid, for this substance is very volatile, and after an article has been impregnated with it, it soon evaporates. Dry cotton should not be applied to cleanse a recent wound lest it carry into it septic material. It should first be wrung out of an antiseptic solution.

"The materials requisite for dressing the wound should now be made ready. They will be referred to in detail hereafter. The hands of the operator and his assistants should next receive attention. They should first be washed with soap and water; the accumulations should be removed from beneath the borders of the nails with the nail brush; and, finally, they

should be washed with an antiseptic solution. This may be a  $2\frac{1}{2}\%$  solution of carbolic acid or a solution of corrosive sublimate one to two thousand. Attention should now be paid to the integument surrounding the wound, for in its sebaceous glands and about the roots of its hairs are numerous foci of micro-organisms, and it would be folly to take precautions to destroy these in the wound and to apply dressings to prevent the access of others, and at the same time to leave unmolested large numbers beneath the dressings and in close proximity to the wound. If the surface be hairy, it should be shaved. It should then be washed with soap and water and scrubbed with a flesh-brush. It should finally be washed with an antiseptic solution of the same strength as that indicated for the hands. Nothing has yet been done to the wound itself, except the temporary staunching of its blood and it is now in order to cleanse its cavity of all foreign bodies, clots and germs. For the removal of foreign bodies the fingers and forceps or other instruments may be employed. A stream of sublimated or carbolated water may also be advantageous and should always be used, if not for this purpose, nor for the removal of clots, at least for the purification of the wound from germs. Carbolic acid is bulky to carry and irritating to the wound and hands, and the corrosive sublimate will be found preferable for the purpose of irrigation, and indeed, for all solutions except the bath for instruments. It can be carried in 8 grain powders, one of which, dissolved in a quart of water, will make a solution 1-2,000. Six feet of rubber tubing with the rectal pipe of Davidson's syringe on the end tied to the handle of a pitcher of this solution and used as a siphon answers every purpose of the most elaborate irrigator. Every recess of the wound should be thoroughly washed out with this solution to destroy the vitality of and wash away all noxious particles. The wound having been purified, any needful operation may now be performed on it. One remark is necessary concerning the handling of instruments. Their immersion in the carbolic bath has already been referred to. Each instrument, as it is required, should be removed from the bath by the surgeon



himself, carried directly to the wound, and, when it is no longer needed, should be again immersed. Under no circumstances should an instrument be laid upon the operating table or bed covering. This is a rule which is insisted on by every operator who has succeeded in antiseptic practice, and there is no rule which is more frequently violated. During the manipulation of the wound, it should, at short intervals, be copiously irrigated with the sublimate or carbolic solution. Whenever it is practicable this irrigation should be continuous. Continuous irrigation offers several advantages over the use of the spray—its absolute reliability in protecting the wound, its



non-interference with the vision of the operator, the practicability of the apparatus, its simplicity and its cheapness. The permanent checking of hemorrhage prior to the closure of the wound is one of the most important duties which devolves upon the surgeon. To vessels of magnitude, the ligature is

probably the best appliance. The material is, by preference, a well-prepared thread of carbolized cat-gut, with the ends clipped close to the vessel. If properly prepared it will be absolved in the course of seven or eight days. Carbolized silk is the next best material. The ends here also should be cut off short in the hope that the knot may become encysted. In placing the ligature, the vessel should be carefully isolated and drawn out from the tissues to insure against the inclusion of nerve-filaments. Medium and small-sized arteries should be twisted. Many operators, indeed, employ this method for vessels even the size of the femoral. In twisting, also, the artery should be thoroughly isolated, for if an attempt be made to twist it with a mass of other tissue, the twisting will be very apt to be ineffectual. The capillary oozing can generally be checked with a stream of very hot or cold sublimated water. A wad of absorbent cotton wrung out of hot sublimated water and held firmly on the surface will generally stop the oozing. I wish to say one word about a very common practice, namely the wiping of a bleeding surface. When it becomes desirable to dry a bleeding surface, it should never be wiped; for every cut surface is thickly dotted with little vessels whose orifices are plunged with little clots. Wiping dislodges these clots and starts the oozing afresh. A wad of cotton wrung dry and pressed firmly on the surfaces will absorb all of the blood and not interfere with the plugs in the vessels. Large vessels, then, are to be ligated with carbolized catgut or carbolized silk; medium sized and small vessels are to be twisted; and oozing is to be checked with hot water, cold water and pressure.

"After the hemorrhage has been permanently controlled the suture should be applied to important structures implicated in the wounds. Any important tendon or nerve which may have been severed should be united. Lateral wounds of important veins and wounds of serous sacs should be closed by the Glover's suture. In all these cases the catgut is the proper thread. These matters having been attended to, it is to be presumed that the wound is ready for closure. The question now comes up as to the necessity for artificial drainage. This

is a very important detail and one for which no hard and fast rule can be laid down. This much, however, can be said: When the surfaces of a wound can be pretty accurately coaptated and an equable compression maintained from without, when it has not been excessively irritated by the application of antiseptic solution and when the hemorrhage has been thoroughly checked, then there is every reason to suppose that the serous discharge will not be so great as to separate the surfaces and prevent their union. In such a case no drainage is necessary. If, on the other hand, the coaptation is imperfect, and the prolonged application of antiseptic solutions has given rise to the expectation of a profuse serous discharge, provision should be made for its escape. Surgeons frequently leave one or more corners of a wound open for the escape of discharges. If this plan is adopted, the most dependent points are, of course, the ones to be selected. The insertion of an artificial drain is, however, a better method and interferes less with the accurate putting together of the wound. Drains are of two general classes, tubular and capillary. The tubular drain should be used for large irregular wounds, the capillary for small ones. Now, as to the material employed for drains. The ideal drain is one which will convey the fluids from the cavity of a wound during the early period of its history when the serous discharge is profuse, which will cause no irritation, and which, when it has survived its usefulness, will be absorbed and will be no impediment to the healing of its track. Such a drain is the decalcified bone drain made from the leg and thigh bones of chickens after the method of Prof. McEwen, of Glasgow. The manner of preparing these tubes is very simple and inexpensive. They cause no irritation, and, at the expiration of seven to fourteen days after their insertion into a wound, no trace of them remains. If a capillary drain be desired, a number of strands of carbolyzed catgut may be used. It pursues the same course with regard to absorption as does the bone drain. For certain cases in which the absorption of the drain is not desired, rubber tubes serve an excellent purpose, and for capillary drainage, strands of silk,



horse-hair and wire. Having provided for the drainage of the wound, surfaces is the next care of the attendant. The first step in opposition is the insertion of sutures. The material for the sutures may be wire, catgut, or silk, or horse-hair. The choice of material will depend upon the amount of support required by the lips of the wound. If the edges are heavy and require considerable support, the silver wire is the best material. If there is to be but little strain upon the stitches, the catgut is the most desirable thread, as it requires no removal, the buried portion being absorbed after the union has occurred. Silk and horse-hair are excellent suture materials. I wish to say a word here in commendation of the black iron-dyed silk, which has appeared to me to be absolutely unirritating. The method of introducing the sutures is also a matter for consideration. The principal sutures now in



use are the interrupted and the Glover's, the former being the most generally applicable. In most wounds, especially those made by the surgeon, one side is much longer than the other. In these wounds it is highly desirable that the fulness of the long border should be equally distributed over the whole course of the seam. To accomplish this and avoid puckering the interrupted sutures are necessary. The first stitch is to be inserted through the middle of each lip, the second midway between the first and one extremity of the wound, the third midway between the first and the other extremity of the wound. In this way, a large amount of fulness can be distributed so as to be hardly perceptible. Whenever the interrupted suture is used, this order should be followed in placing of the stitches, except in the case of wounds opening cavities. The wound has now been stitched together and the matter of supporting the stitches and more exactly coaptating the surfaces comes under consideration. Our first thought is of adhesive strips.

But there is a very serious objection to the use of adhesive strips in large and important wounds in which an aseptic course is in the highest degree desirable.

"That objection is that adhesive plaster must be applied dry and directly to the skin and over the course of the wound. Now, it is extremely doubtful whether there is such a thing as an antiseptic adhesive plaster. I think it may be laid down as a general rule that, whenever a dry substance is to be brought into contact with a wound, unusual precautions should be taken that the substance is itself aseptic and fully charged with antiseptic material. And these precautions, I take it, cannot be insured in a material of such a nature as adhesive plaster.

"I should, therefore, limit the application of adhesive plasters to wounds of the scalp and face in which primary union can nearly always be gained with any sort of dressing and in which the application of sutures is to be avoided, and to small wounds of other regions in which an aseptic course is of trifling importance. External support to the surface can usually be well applied by means of pads of antiseptic gauze held in place by bandages of the same material, or the gauze bandage alone may be used. It should be remembered that this part of the dressing is merely to secure apposition of the wounded surfaces. Before applying the pads and bandages there should be a certain treatment of the suture line.

"Up to this period of the dressing all efforts at antiseptic treatment have been directed toward the destruction of micro-organisms in the wound cavity and its surroundings and the purification of all things that approached the wound. All future efforts are to be directed toward the erection of barriers between the micro-organisms without and the wound with its discharges within. The first barrier should be the dusting of the suture-line with a thick coating of iodoform, which will form, with the secretions, an antiseptic scab under which the wound will kindly heal. Over this, to keep it in place, and as a further protection to the suture-line, should be placed a strip of four layers of a reliable antiseptic gauze wrung dry from an antiseptic solution. The advantages of having this strip ap-

plied damp are, that it clings more closely to the suture-line, and being fresh from a solution of known antiseptic power, it may be relied on to protect the wound from impurities which may have accidentally adhered to the dry external dressing. Carbolated gauze is not desirable for wound dressing, because it is expensive, deteriorates when kept and loses its carbolic acid unless carefully protected by an external, impermeable dressing. Iodoform gauze is very reliable, but is expensive. It is easily made by saturating cheese-cloth with an ethereal solution of iodoform. This process occupies but a few minutes and yields an admirable result. The cost, however, of the bare material is about 20 cents per yard. Another method, which is somewhat more troublesome, but less expensive, is to sprinkle the gauze with iodoform from a pepper box. The cost of gauze so made is about 12 cents per yard. In the preparation of any antiseptic gauze, it is necessary first to extract the grease from the cheese-cloth by boiling with washing soda and subsequent rinsing. Sublimated gauze costs merely the price of the cloth and can be made by saturating the cloth with a solution of bichloride, one drachm to the quart, and hanging out to dry. This gauze, or the iodoform gauze, is to be used for the four layers which cover the suture-line, and for the compression pads and bandages. We must now make provisions for the serum and blood which will probably drain from the wound during the first two days; for, if the discharge be allowed to reach the surface and pass the barriers of antiseptic material, decomposition may extend to the wound in a very brief period. We must provide enough of absorbing material to take up the discharge and this material must be deprived of organisms by thorough saturation with an antiseptic. Where the discharge is not great, masses of iodoform gauze, or sublimated gauze, charged with the same materials, is all sufficient. If a profuse discharge be expected a more absorbing material is desirable. This may be wood-wool, sand, peat or saw dust. Of these materials my experience extends only to saw dust, and it has proved perfectly satisfactory. It may be easily prepared by soaking in a solution of bichloride and afterward

drying. This prepared sawdust is used as a filling for pillows of different sizes made of antiseptic gauze. Having placed an abundant quantity of absorbing antiseptic material over the wound in every direction, and particularly beneath the openings of the drains, and bound it on securely with muslin rollers and fixed the part at rest on a splint or otherwise, the first dressing is completed.

"The after-treatment of wounds should be largely governed by the idea that during the first two days there is apt to be a greater or less amount of serous oozing and that this discharge in its natural state is a favorable medium for the development of organisms. If, however, the primary dressing has been applied with proper care, there is no fear of this discharge becoming infected till it shall have soaked through the prepared absorbant dressing and reached the external muslin bandage. The rule then should be to remove and reapply the external absorbant dressing as soon as the serum shall have reached the surface, though it is rare for the dressing to require removal more than once or twice from this cause. If the discharge, as usually happens, should not reach the surface by the third day, it is advisable to remove the external absorbant dressing and replace it by a fresh one, and thus eliminate the possibility of putrefaction in this medium. All after-dressing should be conducted with the same scrupulous care for detail as in the primary dressings and the wound should be exposed only when protected by a stream of antiseptic solution. Unless there is some indication of tension upon a stitch or retention of discharge, the compressive dressing need not be disturbed. After the third day the amount of absorbant material may be reduced, six or eight layers of gauze being sufficient, as there will probably be little or no more discharge. After the primary serum has been disposed of, the dressing may be left on indefinitely, but it is proper to open it on the eighth or tenth day for the removal of the stitches.

Now, what results are we to expect from this method of treatment? In recent wounds, whether incised or lacerated, provided none of the tissue has been devitalized, primary union

without suppuration may be expected in almost every case.

I speak now not only of cases in which the apposition is accurate, but also of those in which it is only approximate, such as amputations of the breast, leg and thigh. In those wounds which are complicated by the devitalization of tissue, the dead tissue lies harmlessly in the midst of the living and, in the course of time, separates and can be removed. In the case of large sloughs there is usually slight suppuration but rarely sufficient to require dressing oftener than every second or fourth day. There are no inflammatory symptoms to be observed about the wound. There is no irritative fever; the temperature rarely rises above  $101^{\circ}$ , and usually not over  $99^{\circ}$  or  $100^{\circ}$ . The advantages of this system of dressing are, rapidity of healing, absence of high temperature, freedom from suppuration in most cases, and immunity from blood poisoning. If, in addition to these safeguards for the patient, the infrequency of dressing and freedom from anxiety by the surgeon be considered, it would seem that the idea of wound infection should receive attention in the treatment of every wound.

## CHAPTER VI.

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### FRACTURES.

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#### GENERAL OBSERVATIONS.

The bones have three uses : First, to protect delicate organs, such as brain, heart, lungs, spinal cord, etc.; second, to serve as levers upon which the muscles may act to produce motion, and third, to maintain and preserve the shape and symmetry of the body.

The bones are composed of animal and mineral material, which varies with the age of the individual. In an adult the proportion is about one-third of the former to two-thirds of the latter. In younger persons the animal material is nearly equal to the mineral, while in old persons the mineral greatly predominates. Consequently the bones of young persons are not so easily fractured as those of persons more advanced in years. When the soft parts, such as a muscle, ligament or tendon, are separated by force it is said to be lacerated or torn, but when a bone is separated into two or more pieces it is called a fracture. Bones are organized and grow the same as any other tissue, being filled with numerous blood vessels and nerves; the former carrying the required nourishment for the growth, development and repair when fractured, so that the recuperative process can consolidate a fractured limb and make it as firm and strong as it was before it was broken. Much will depend



upon the age and general condition of the patient, and also the nature of the injury.

Fractures are classed, according to the best accepted authors, as complete, incomplete, compound and complicated. A complete fracture is where there is an entire separation of the bone into two parts. An incomplete fracture is where there is only a partial separation, such as is known as a "green stick" fracture and fissures and indented fractures. A simple fracture is where the bone is broken at but one point but has no reference to other complications. The term "single" instead of "simple" would be preferable were it not that it might prove a source of confusion.

A comminuted fracture, which is also called "multiple," is a fracture in which the bone is broken at more than one point and into more than two fragments, but does not mean that the bone has been divided into minute pieces or that there is a comminution of the fragments. A compound fracture is one where there exists an external wound communicating with the point of fracture. Complicated fractures are those where there is an injury to nerves, blood vessels, or any of the tissues, with constitutional disease, such as syphilis, tuberculosis, scrofula, or with a dislocated joint, contusion or laceration of the soft parts. Hamilton also divides fractures into transverse oblique, and longitudinal, according as the direction of the line of separation is at a right angle to the axis of the bone at the point of fracture or as it deviates more or less from this direction. There are still other divisions such as impacted, serrated, denticulated, etc.; but in a work of this character it is not deemed necessary or wise to multiply these divisions.

*Causes.*—These are predisposing and exciting. The influence of age and the general health of the patient have much to do in causing fractures, especially if there should exist any fault in the nutrition of the bones brought about by disease, such as rickets, caries, necrosis, cancer, scrofula or syphilis, which would render them extremely liable to fracture. There is also a tendency to fracture in old people from the fact that the bones become chemically altered, as the earthy matter

greatly predominates over the animal, rendering them extremely brittle. The exposed position of the bone is also a predisposing cause, consequently the long bones, especially those of the extremities, are more liable to suffer from fracture.

The exciting or immediate causes of fracture are of two kinds—mechanical force or violence and muscular action. Mechanical force or external violence is much the more common, and this may act in two ways: One when the force is applied directly to the bone at the point of fracture, which is then called “direct violence;” the other when applied at some point remote from the place of the fracture, which is then termed “indirect violence.” Hamilton applies the term “counter-stroke” to this remote application of force. When a person is thrown from a car and alighting on his feet the leg is broken, the fracture is from indirect violence or counter-stroke; but when the arm has been caught between the deadwoods or drawbars and a fracture has resulted the term “direct violence” is used. Railway surgeons have more to do with fractures caused by direct violence than by the indirect.

The great degree of injury to the soft parts in cases of fractures from direct violence may frequently, especially in some situations, prevent the fracture from being discovered. This is often the case, in the crushing injuries of the hand or foot, when the most skillful surgeons are known to have failed in making a correct diagnosis of the case until after the swelling had subsided. Fractures caused by muscular action are not very common, yet the writer has known cases where from the powerful muscular effort made to escape the danger, such as jumping from an engine or train while in motion, the patella was fractured, the result unquestionably of excessive muscular action.

Prof. Hamilton says that “he has seen one example of a fracture of the shaft of the femur in a large and perfectly healthy man occasioned by a twist of the leg in rolling ten-pins.” In the city of Fort Wayne, Ind., a case occurred, a boy, æt. 8 years, where there were fourteen fractures produced by muscular action, all uniting, and the young man is now in good health and quite strong.



*Signs of Fracture.*—The symptoms of fracture are generally well marked and yet are liable to be confounded with extensive contusions and dislocations; especially if the fracture has taken place near the joint, when the differential diagnosis becomes quite difficult. The most prominent indications are unnatural mobility at the point of fracture, crepitus and an inability to hold the fragments in their proper relations when reduced without mechanical appliances. Unnatural mobility is a sign of great diagnostic value, being always present and never absent in some degree, in all complete fractures. To develop this positive symptom one fragment must be grasped and held firmly; the other moved in a different direction, when the limb will bend at the point of fracture. In the clavicle the mere weight of the shoulder will produce the deformity and by moving the arm up and down the fracture can be easily discovered. Crepitus is occasioned by the rubbing together of the ends of the broken bone and is a positive evidence of fracture. Dr. Hamilton says that "it is possible to confound the chafing of engorged tendinous sheaths or of inflamed joints upon which fibrinous effusions have occurred, or of emphysema even, for true crepitus of a fracture, but to the experienced ear and well practiced touch these sensations are seldom a source of error." In cases where a fracture has existed for some time before the examination is made, when there is much swelling and some inflammation so that the ends of the bones have become partially covered with a plastic material, or when a sheath of muscle or tendon has been formed between the fragments, the crepitus may only be faintly transmitted or may not be heard at all, so that the absence of this sign is not to be regarded as evidence that the bones have not been broken. In some cases the action of the muscles is such that it is impossible to bring the ends of the bones together. Inability to hold the fragments in their proper relations without mechanical appliances is a very prominent symptom of fracture. The muscles being fretted by the injury are violently contracting and displacing the fragments so that after the limb has been extended and the fracture reduced the displacement will soon recur.

*Diagnosis.*—With the enumeration of the general symptoms just given it would seem to render the diagnosis of all fractures very easy, and except when near a joint in the long bones the diagnosis is not very difficult. In the bones of the carpus, tarsus and cranium it is frequently attended with considerable difficulty. We have found some fractures of the radius when near the articulation to be quite difficult to make out. Great care is therefore necessary in the diagnosis of all fractures, especially if near an articulation, and in cases of doubt the patient should be fully etherized and thoroughly examined. Every surgeon should fully satisfy himself of the true character and extent of the injury he is called to attend, especially in cases of railway accidents. Always make a most thorough and complete examination of every case of injury where a fracture is suspected, we would, however, caution the surgeon in making his examinations while the patient is under the influence of an anesthetic, not to handle the injured limb in a rough manner, for the reason that in doing so very serious injury may be done to the soft parts, including important nerves and blood vessels. It is no longer regarded as an evidence of skill upon the part of the surgeon who handles his unfortunate patient in a rough and unfeeling manner, but rather the reverse. A good surgeon is kind and tender in all his manipulations of the injured. The railway surgeon has to deal with a class of cases which from their complications and serious nature deserve especial consideration and do not come under the same treatment and management that other accidents do. They are more severe from the effects of the heavy machinery producing the injury, causing a greater shock, and consequent nervous depression. An arm or a leg is caught by the dead woods or draw bars, or crushed by engine or car wheels, producing a comminuted fracture, the patient suffering from the shock which is great, and the soft parts severely bruised; without making the most careful examination, and that while the patient is under the influence of an anesthetic, the surgeon will not be able to determine whether the limb can be saved or not. These cases require careful investigation and the pa-

tients are entitled to the surgeon's best skill in making the examinations.

The writer is well satisfied that he sacrificed some limbs in his early surgical practice that he would now save.

*Process of Union.*—Many experiments have been made upon the lower animals and have contributed something to a better understanding of the subject of repairs to broken bones. In the simplest form of fracture where there is not much injury to the soft parts, and the periosteum is not much damaged, the process of repair sets in at an earlier period than in cases where there is a compound, complicated or comminuted fracture. When there is much effusion of blood at the point of fracture the process of healing will be much retarded. If the periosteum is injured or the fragments partially denuded the recovery will be much delayed. Space will not be occupied in this work by setting forth the various theories in regard to the repair of broken bones. A few practical points and well established facts in regard to this subject will suffice.

It is now fully established that the reparative material, consisting originally of plastic lymph, is poured out from the vessels of the Haversian canal, the medullary tissue, the periosteum and in fact from all the tissues around the seat of the injury; but no doubt the greatest abundance from the periosteum. This lymph, after a period longer or shorter, becomes organized and receives some osseous material, through which the bones become consolidated. After an injury is received causing a fracture, the first thing in the reparative process is to clean away the debris, and prepare the tissues for repair; consequently there is always more or less inflammation with an increase of blood in the region of the fracture which results in the cleaning up of the parts and the pouring out of the material necessary for the repair of the injured bones. We find the following in F. H. Hamilton, on "Fractures and Dislocations."

"Dupuytren, enlarging upon the doctrines taught by Galen, Duhamel, Camper and Haller, declared that nature never accomplishes the immediate union of a fracture, save by the

formation of two successive deposits of callus, one of which is derived from the periosteum, the adjacent tissues and from the medulla, while the other, derived perhaps from the broken extremities of the bone itself, is found at a later period directly interposed between their surfaces. The material or callus derived from the tissues outside the bone, and which Galen compared to a ferule, but which Mr. Paget calls 'unsheathing,' together with the material derived from the medulla, compared often to a plug, and by Mr. Paget named 'interior callus,' is by Dupuytren spoken of as the 'provisional or temporary callus,' by which the fragments are supported and maintained in contact until the permanent callus is formed. This temporary splint is completed or has arrived at the condition of bone in a spongy form at periods varying from twenty to sixty days; but it does not assume the character of compact bone until a period varying from fifty days to six months has elapsed, after which it is gradually removed by absorption. The second process by which the ends of the bone are definitely or permanently united commences when the provisional callus has arrived at the stage of spongy bone and is not completed usually within less than eight, ten or twelve months, when, says Dupuytren, it acquires a solidity greater than the original bone."

Dr. Hamilton on the above says by way of comment: "While it is certain that this eminent surgeon and most accurate observer has described faithfully the various phenomena which usually accompany the repair of bones, in those animals which were the subjects of his experiments, and that his conclusions have a certain degree of application to the human species, it is equally certain that he erred in assuming that in man simple fractures always unite by this double process; yet such is the power of authority, these doctrines were accepted from the first without hesitation or debate, and for nearly half a century they have occupied the minds of surgeons to the almost complete exclusion of every other theory. Mr. Stanly was among the first to question the solidity of the doctrines of Dupuytren, but it remained for Mr. Paget

to expose fully their fallacies; nor has Malgaine, although not strictly a disciple of Paget, failed to detect certain of these errors. I think it may now be fairly stated that the repair of bones by the double process described by Dupuytren is in man only an exception to a very general rule; and that fractures may unite by either of the following rules:

"1. Immediately, or in the same manner that the soft tissues sometimes unite, by the direct reunion of the broken surfaces and without the interposition of any reparative material.

"2. By interposition of a reparative material between the broken ends, as when the fragments remain in exact apposition but immediate union fails. This is especially apt to occur in superficial bones, such as the tibia, or upon those sides of the bones which are most superficial.

"3. Bones broken and not separated unite occasionally by the process described by Dupuytren, namely, by the formation, first, of an ensheathing callus, whilst at the same moment the cylindrical cavity becomes closed by a spongy plug, or its canal is merely interrupted by a compact septum of bone; and second, by the definitive callus deposited between the broken ends. It is probable that this happens generally in children or during the period of the greatest activity in the development of bones; and it is a common mode of union in the ribs, which during the whole progress of the union are necessarily kept in motion.

"4. Under similar circumstances, when no displacement exists, the fracture may unite by ensheathing the interior callus alone, no intermediate callus even being found between the broken ends; in which case it may be probably said that the bone itself has never united, and the ensheathing callus, instead of being provisional, is permanent or definitive.

"5. When bones are broken and overlap they may unite by the interposition of a callus between the opposing surfaces, that is, by an intermediate callus, but which will differ from that described as the second method inasmuch as the new material will be deposited upon the sides of the fragments and



not upon their extremities. The limb being kept perfectly at rest and all other circumstances proving favorable, this union may take place without any excess or irregularity in the deposit. The surfaces will unite firmly when they are in actual contact; and smooth and well formed buttresses will fill up all the spaces between the bones when they are not in actual contact sufficient generally to give the requisite strength to this new bond of union. This mode of union will be completed sometimes when the two ends of the bones are separated laterally an inch or more from each other.

"6. The fragments being overlapped more or less, and suffering unusual disturbance, or the adjacent tissues having been much torn, or much blood being effused so that considerable inflammation is caused, the amount of callus will exceed what is necessary for the complete union of the bones, and this redundancy may be deposited around and upon the broken ends of the bone, or anywhere in their immediate vicinity, in layers or in masses of irregular shape and size."

All compound fractures or complicated fractures obey no uniform law of repair, but each individual case will present a different phenomenon, and the process of repair will differ from all the methods just named. When extensive inflammation and suppuration follow a compound fracture, if any superficial callus is found it will be very spongy, and while it may be very large, yet it will be weak, and the union will not be a firm one until the lapse of many months, and in some cases of personal observation, when the callus was absorbed, it was found that no permanent union had taken place.

*Prognosis.*—Most of the fractures of the long bones, when the nerves and blood vessels are not injured, will unite, and, if properly adjusted, without any deformity.

In fractures occurring among railroad men where the injury has been caused by the direct violence of the heavy machinery the result cannot be expected to be so favorable. Very frequently if the limb can be saved at all it will be with a certain degree of deformity, on account of the severe contused condition or the soft parts, so that no splints or appliances can

be employed to hold the fragments in their proper relations. Yet it is much better to save an arm, or hand, or even a leg, with some degree of deformity, than to sacrifice it. Especially is this correct in regard to upper extremities. Anchylosis to a certain degree will follow all fractures. In some cases, however, it is only temporary, in others permanent. Should the point of fracture be near a joint and the inflammation be extensive, the anchylosis is unavoidable.

In some cases it may give way in a short time, in others it will be complete. In regard to the shortening in oblique fractures of the long bones, especially those of the femur, so much has been said in late years that it is only remarked here that in some cases it is possible to have a complete recovery without any shortening, but in many cases, and with the most skillful treatment, shortening seems to be inevitable; and it is certainly dangerous at this time to claim that it is bad surgery when there is any perceptible shortening in these cases, for it is of personal knowledge that when the best of skill and the most excellent appliances have been used cases have been reported with some degree of shortening. In the treatment of many cases of fracture caused by railway injury, it was found absolutely impossible to prevent some degree of shortening for the reason that the soft parts were so badly injured that it was impossible to hold the bones in their proper relations. In railway surgery it cannot be held that shortening is the exception to the rule.

*General Treatment.*—The first indication in the treatment of fractures is to adjust the broken bones by bringing them into complete apposition and in holding them in place until consolidation is effected. It is not necessary that a fracture be reduced immediately after the injury is received. The patient should be placed in as comfortable a position as possible, the fractured limb extended and supported with some clothing, or even some splints, until the nature of the injuries can be fully ascertained, and reaction at least partially established. It is highly improper as well as cruel to rudely manipulate a fractured limb while the patient is suffering from shock and the



heart is beating feebly, and the surgeon unable to determine whether the patient will survive or not. In such cases extend the limb so as to prevent the sharp ends of the bone from goading the soft parts, and then wait for reaction to be established. Handle the patient gently. It is a sad example of "man's inhumanity to man" when a surgeon grasps a fractured limb, handles it roughly while the sufferer is as cold as death, with no pulse, and but little prospect of reaction being established, causing him additional pain and thus increasing the shock. As Dr. J. T. Woods, of Toledo, Ohio, said in a paper read at Decatur, Ill., January 25, 1881, "Every pain is a twinge at life." Rude and awkward handling, so as to give needless pain, should be avoided, and no good surgeon will ever inflict an unnecessary pain.

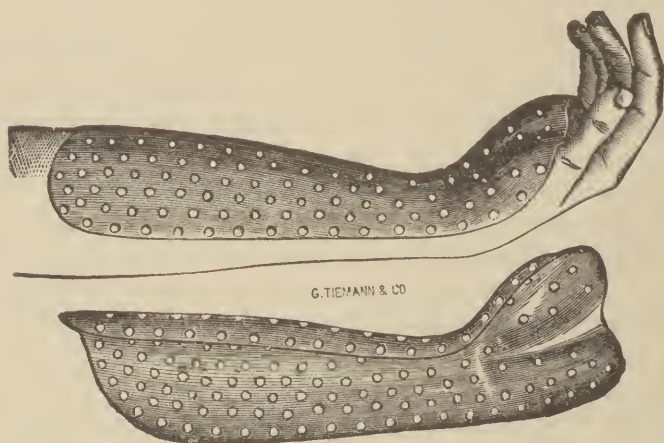
Some men who call themselves surgeons think it necessary, in order to show how skillful they are, to be hard-hearted and unfeeling in all their practice, but such men certainly have mistaken their calling in life. A surgeon should be a man of refinement and sensibility, easily affected by human suffering, so that he can handle those who are so unfortunate as to be injured, with tenderness. But some men can never be taught, and it is greatly to be desired that railway officials may learn that men who are unfeeling, or, as the laity say, are "very rough," should not be employed as surgeons to minister to their unfortunate injured men. They have no right to practice the humane art. When a fracture can be reduced without giving much pain, and the patient is not suffering from shock, there can be no objections to the reduction of the fracture and the employment of appliances to hold the bones in position at once. The surgeon must exercise his own good judgment in these cases. What is objected to is the needless handling of a fractured limb, and thereby increasing the danger of the patient and interfering with the chances for reaction to take place.

Dr. Hamilton says that experience has indeed furnished us with four or five very good reasons why broken bones should be reduced as soon as possible. When the injury is recent the

muscles offer less resistance, the resistance being increased after a time not only by the reaction which ensues upon the shock, but also by actual adhesion between their fibres; effusions distend both the muscles and the skin and compel the limb to shorten; the constant goading of the flesh by the sharp points of the broken bones increases the muscular contractions; the patient will submit readily to manipulation and extension at first, but after the lapse of a few days it is very seldom that he will permit the limb to be in any manner disturbed, even if he is assured that his refusal entails upon him great deformity.

It is not advisable that the delay should be for a few days, but only for a few hours, until reaction is partially established. Give the patient a chance for his life and then reduce the fracture. It is not necessary to wait until actual adhesions have formed. The muscles are not very resistant when reaction is being established. Delay is by no means advisable until inflammation has set in. Certainly not; only wait until it is known that the patient will survive the shock, which is always greater in fractures from railway injuries than from other causes. Surgeons have been known to spend several hours in reducing and dressing a fracture, and when the dressing was completed the patient died. How very cruel to thus torture a dying man! And it has occurred to the writer that if the patient could have been kept quiet and free from pain, with the proper treatment reaction might have been established and the patient lived. In the use of dressing for fractures some surgeons have been in the habit of covering the broken limb with a primary bandage before applying the splints, but it is a matter of rejoicing that this practice is now almost entirely abandoned. These primary dressings are not recommended because their use involves unnecessary handling of the injured limb without any compensating benefit whatever. They are liable, indeed, to do much harm. It has been claimed by the advocates of these primary dressings that they prevent the muscles from contracting and thus displacing the fragments, but the proper application of splints will as certainly overcome

this tendency as the primary bandage, without incurring the danger of applying this inner bandage so tightly as to strangle the limb, which is often done, as has been noted in the observation of the author. For the second indication, namely, to hold and maintain the fragments in place, many appliances have been tried and recommended. The material from which these splints may be constructed is of some importance for the reason that so many different kinds of appliances have been recommended, and all made from different material. It will be well for the railway surgeon to understand how to prepare suitable dressing from such material as he may have at hand



at the time of making the dressing, for the reason that he will not always have on hand such splints as he would prefer; consequently, he must make use of the material at his command, and make the most of his imperfect resources. Many metallic splints have been used, and found of a variable degree of value, such as lead, zinc, tin, perforated sheet iron, wire gauze, copper, etc. A metallic splint made of perforated tin or zinc is preferable to any other of the class named, as it can be hammered and shaped to fit the limb. Whalebone quilted into cloth has been found useful. Wooden splints of various patterns have been manufactured and offered to the profession in

different sizes; in fact their number have been legion. The railway surgeon will have to be content in the use of such splints as may be obtained at the time of making the dressing. A good dressing is secured by using ordinary pasteboard placed in hot starch, and from four to six layers cut so as to make a mould for the fractured limb, covering the inside of the mould so made with fine cotton. Apply carefully with a roller bandage, and on the outside place a wooden splint, only to remain until the starch becomes dry and firm; then remove. This will give a perfect mould for the limb which will be found firm and very comfortable. This is preferred to the plaster-of-Paris dressing for the reason that it is more easily applied and will not be crumbling and strewing the bed of the patient with particles of the plaster. Again, the material for this dressing is found in nearly every household, while the plaster is not. Splints of light wood, such as pine, willow, or linden wood, are more generally employed than those of any other material, and are of more value in the treatment of most fractures. The patented wooden splints which are manufactured and sold to the profession are not recommended, for the reason that they never exactly suit any one case. If wooden splints are used, they should be made to suit the case in hand. It is not necessary to discuss the value of the different forms of splints employed, such as undressed leather, wool felt, cloth saturated with gum shellac, gutta serena, etc. In regard to the immovable dressings, the writer confesses that while the results have been seemingly satisfactory and gratifying to those who have used them, he has never had the courage to try them, for the reason that he had fears that some slough might form without his knowledge; and certainly where there are injuries to the soft parts there is much danger. In cases, however, of simple fracture, in which there has been but little injury to the soft parts, the "immovable apparatus" may be employed. In cases of compound fracture the parts should be thoroughly cleansed by the use of the flesh brush, soap and water, shaving the limb, and bathing the wound with the solution of the bichloride of mercury. This must be done very thoroughly.

See that the extravasated blood and all foreign substances are removed, as far as it can be done, using warm water with the addition of the sublimated solution. When this has been done the fragments should be brought together and a dressing of antiseptic gauze, with iodoform, placed on the wound. This dressing should be very thick.

Finally, let a permanent dressing be applied over the antiseptic gauze, so as to hold the parts in their proper relations. This dressing should not be removed for several weeks unless there should be a rise in the temperature indicating some inflammation in the wound. An increase of one or two degrees of temperature above the normal is not sufficient to warrant the removal of the dressing. The question whether a wound should be closed in cases of compound fracture must be left to the judgment of the surgeon.

If there is not much extravasation of blood, and the hemorrhage is easily controlled so that the wound can be dressed antiseptically there seems to be no objection to the closing of the wound. A clot of blood is to a certain extent a foreign substance and should be removed before the wound is closed; likewise the hemorrhage should be arrested and the wound thoroughly cleansed. Of course this cannot be done when there is much contusion or laceration of the tissues. In such cases hot water should be employed to cleanse the parts. This process may be continued for hours and in very aggravated cases even for several days before the wound is in a proper condition to close. Ice or cold water, in the treatment of fractures, is always injurious and should never be used. Should the patient suffer much pain a good dose of opium should be given and in all cases of injury it is preferable to administer this drug hypodermically. In some cases the patient will be very nervous and it will be necessary to give an anesthetic before the nature of the injury can be fully determined; but the patient should be handled very carefully even though he be insensible to any pain. Rough manipulation may produce very serious injury to soft parts. Always handle a fractured limb with gentleness as any movement of the sharp



ends of the bones may wound an important nerve or blood-vessel.

#### FRACTURES OF THE NASAL BONES.

In fractures of the nasal bones, with displacement, the fragments should be replaced as accurately as possible by pressure from the nostril. A female catheter is the instrument usually recommended to effect the replacement of the bones, but its point is too large, especially when the parts are much swollen. The end of a small sound will be found much better for this purpose. The replacement should be made with great care for the reason that a very slight misplacement will leave a great deformity. This care should always be exercised in the treatment of fractures of the face. No plugging of the nostril is required, nor the application of adhesive plaster. In most cases of fracture of the nasal bones in railway accidents, the violence has been so great as to cause injury to the ascending processes of the superior maxillary, ethmoid and vomer, and sometimes the turbinated bones. The nasal duct may be lacerated and the Schneiderian membrane be torn, so that there will be profuse hemorrhage. There may also be emphysema, the air from the nostrils finding its way from cell to cell, or tissue to tissue, until all the parts of the nose are inflated. The parts should be thoroughly cleansed, especially if there be much contusion, with laceration of the parts, and a warm water dressing, slightly carbolized, applied, and the patient required to remain quiet in his room or bed. As soon as the swelling subsides any appreciable deformity will be discovered, and an effort should at once be made to replace the fragments and restore the proper form. The superior maxillæ are subject to various injuries, but there is seldom room for much surgical treatment.

The following is a case of personal experience in treating a case of this character: A brakeman while making a coupling attempted to "set the pin" just as the engine backed up. When it struck the car the pin flew out of the drawbar and

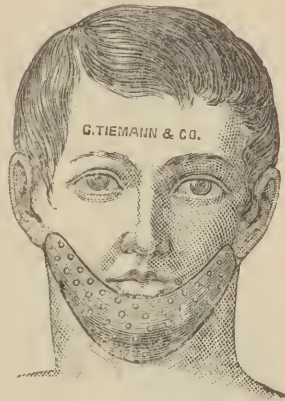
dealt him a violent blow on the upper jaw, causing a fracture and driving the incisor teeth upward into the nostril, contusing the upper lip in a fearful manner. No difficulty was experienced in removing the teeth and replacing the fragments, which were held in their proper place by the use of the wire. Union took place without any trouble and after recovery there was no deformity.

*Fracture of the Antrum and Depression of the Malar Bone.*—A very serious deformity is caused by a fracture and depression of the malar bone. These bones are very thin and vascular; consequently union will take place at an early date. A few years ago the writer was called to see a conductor, who, in making a coupling of cars loaded with lumber, the ends of the boards extending over the ends of the cars, had his head and face caught between the ends of the boards, receiving a compound fracture of both malar bones, with a depression of the antrum. In this case there was considerable hemorrhage from the wound in the soft parts, very extensive contusion, and some laceration about the head, ears and face. Deformity was averted by introducing a hook under the zygoma and lifting it up, and also by taking hold of the periosteum with a pair of ordinary forceps and elevating the depressed bone. The usual method of replacing the fragments and depressed bone is by making an opening in the antrum through the alveolar process, and then pressing up the fragments through this opening by the use of a sound. In case the alveolar process is fractured, the teeth in the broken fragment should be secured to a firm tooth, if there be one, by a silver wire.

*Fracture of the Lower Jaw.*—The lower jaw is frequently fractured by being caught between the cars, or by falling from a moving train, or in making couplings when there is lumber or other material projecting over the end of the car. During the last year a case was presented for treatment where the fracture was caused by projecting gas pipes striking the brakeman as he was making a coupling. In this case the deformity was great, but the bones were replaced without much trouble and held in place by the silver wire.



Some instances have occurred of only a simple fracture at one point, and a compound fracture on the opposite side, showing that the force producing a compound fracture on one side may cause a simple fracture at a remote point of the bone. In order to reduce such fractures the patient should be required to sit on a stool or low chair, leaning his head against the surgeon, standing behind him, who with his thumb and fingers can easily replace the fragments. Any tooth that has been loosened had better be removed for the reason that it may interfere with the process of union. If there is much displacement and the teeth contiguous to the fracture are sound they



should be united by wire, so as to be held firmly, and then if the upper and lower teeth are mostly sound the lower jaw should be brought firmly against the upper jaw. It may be necessary, if no tooth has been loosened by the accident, to extract one for the purpose of making an opening through which liquid food may be given, as the patient will be compelled to live on food that can be swallowed without mastication.

No splint has been found of any value in these cases and personal experience has demonstrated that the patient will feel more comfortable if nothing is placed in the mouth between the teeth. Certainly the upper teeth will be the best support

that can be had for the lower jaw, and there is nothing in the mouth of the patient to become offensive and a source of great annoyance to him. To repeat, the treatment which has proved the most successful is: First, replace the bones as directed; use the silver wire to bind the fragments together to the sound teeth; then bring the lower jaw firmly against the upper and hold it there with firm bandages and splints. The latter can be made of pasteboard and starch, or perforated tin. A very good splint can be made of leather; but no matter what kind of material is used the splint must be held in place by good bandages.



The dressing should not be removed for four weeks and if there is much injury to the soft parts followed by profuse supuration the bones will be longer in uniting.

The older authors recommended the use of corks, placed in the mouth between the teeth on each side in order to keep the jaws apart and in that way food could be taken without the removal of a tooth, but we would much prefer the removal of a tooth to make an opening through which a tube may be passed into the mouth, and through it the required food taken.

The simplest and most efficacious form of bandage is made, with a piece of muslin a yard long and about four inches wide. A slit four inches long is made longitudinally in the center and the ends of the bandage are torn down to within three or four inches of this slit. The chin is then placed in the slit, the anterior tails are tied behind the nape of the neck, and the posterior ones on the top of the head, and then both sets are tied together to secure them firmly in their places.

#### FRACTURES OF THE CLAVICLE.

Fractures of the clavicle are of frequent occurrence, and result, if not properly treated, in limiting the use of the arm. Any direct force may cause a fracture of this bone; or an indirect violence such as a fall or a blow on the shoulder. A number of cases have been treated where the fracture was the result of the direct force of a moving car striking the patient on the shoulder; others, where he was caught between the cars; and one, where he was caught between the tender and the projecting pipe at a water station.

This fracture is very common among railway employes, and every surgeon should prepare himself for the treatment of it. It is claimed by statisticians that this fracture stands fifth in the order of relative frequency, but certainly in the experience of the author it stands much higher.

*Diagnosis.*—The diagnosis is easily made if sufficient care is taken in the examination of the case. When the fracture is complete with the displacement of the fragments there can be no difficulty in making a correct diagnosis. Dr. Hamilton says: "The patient is found, generally, leaning toward the opposite side while the opposite hand sustains the elbow of the same side to prevent its dragging downward." The shoulder always falls downward and forward.

*Treatment.*—The treatment recommended by some surgeons, of placing the patient flat on his back, and compelling him to lie in that position for at least two weeks, is not often if ever practiced. This course of treatment might do where perfect

symmetry is very desirable as in the case of a young lady who would not consent to any deformity whatever, but few patients will submit to such a course. In most cases it will not be required to confine the patient in bed or even indoors; the fracture must therefore be firmly fixed so the patient may move about at will. In order to replace the fragments let the patient be seated on a low stool; then, the clothing being removed from the upper part of the body, let the surgeon, standing behind him, grasp both shoulders with his hands, place his knee between the shoulders, press with considerable force and at the same time with his hands elevate and draw back the shoulders. Thus the deformity will be removed, and the fragments brought to their proper position. To hold them so the arm must be held firmly to the side. Many appliances have been recommended for this purpose. An ordinary roller bandage with an axillary pad is a good dressing. The double figure 8 bandage is the only dressing used by some surgeons for the shoulders, but it has not proven efficient in the practice of the writer. Broad strips of adhesive plaster have been used, are highly recommended and are coming into general use. They are not, however, without their drawbacks, for the reason that they produce some irritation of the skin, and in children cause much fretfulness. Notwithstanding, they prove a very efficient dressing. The method of application is to cut the adhesive plaster into strips about three inches wide and long enough to go around the arm and body. The arm being held in position the plaster is fastened around it with a few pins or stitches just above the elbow. The strip is then carried around the body and over the arm so it will cover the piece on the arm. The next strip is carried over the well shoulder, down across the elbow, so that the arm will be drawn upward and backward, and held in position by the firm adhesion of the plaster to the back and breast, thus holding the forearm against the chest. This is a good dressing and the only kind we have employed for over ten years, with the most gratifying results.

The axillary pad recommended by many very excellent

surgeons is objectionable by reason of its excessive pressure on the brachial artery and nerves. Dr. Coats calls attention to this danger and it will be well for the surgeon to look after this, so as not to interfere with the circulation of the blood and thus check the nutrition of the arm. In personal practice the axilla pad was discarded a number of years ago for this reason, and it is not considered at all necessary in the successful treatment of fractures if the arm is held in the position described by using the adhesive plaster.

#### FRACTURES OF THE RIBS.

Fractures of the ribs may be caused by direct force at the seat of fracture, or by the chest being compressed by opposing forces, as occurs often in coupling cars. Cases are not uncommon where the fracture results from falling from the top of a car and striking a stone, or other hard substances. A case in personal practice is recalled where the patient fell from the top of a car while in motion, striking on a rail and sustaining the fracture of four ribs. In all of these cases, whether the fracture is caused by direct or indirect force, there is great liability to a serious complication with a wound to the internal viscera, such as the pleura, lungs, or muscles, which may result in dangerous inflammation. In fact in most of the cases resulting from railway accidents the force producing the fracture will, to a certain extent, cause more or less injury to the internal viscera.

The symptoms of the fracture of the ribs are: First, sharp pains caused by the ends of the broken bones pricking the pleura at every inspiration, which is checked and so lessened in volume that the chest cannot be properly expanded. Second, crepitus at the point of fracture. This symptom, however does not always prevail. By passing the hand or finger along the course of the rib the fracture can generally be recognized and definitely located. Any deformity is seldom apparent.

*Diagnosis.*—The symptoms are generally so clearly defined



that if proper caution is exercised in making the examination there is no difficulty in establishing a correct diagnosis. The history of the case will be of much service in arriving at a clear understanding of the nature of the injury.

*Prognosis.*—Where there is no complication the prognosis is generally favorable, but as stated before, in the great majority of cases the force causing the fracture will also have produced injury to the internal viscera, so that in most cases there will be a complication, and the surgeon should be guarded in his prognosis, for, should the fracture be followed by pneumonia or pleuritis, the prognosis will be much more serious.

*Treatment.*—The indications for treatment are to keep the fragments at rest. This can be accomplished at once by grasping the shirt or undershirt and drawing it tightly around the body of the patient, and fastening it with pins so that the breathing will be through the movement of the diaphragm, and not by the expansion of the chest and consequent elevation of the ribs. A good dose of opium should also be administered at once. A hypodermic injection of morphia,  $\frac{1}{4}$  to  $\frac{1}{2}$  gr. combined with the one-sixtieth grain of the sulphate of atropia may be given with good result. Opium will reduce the number of the respirations and relieve the pain, and thus prevent inflammation of the pleura and lungs. It is certainly the best known remedy in such cases.

After the patient has been removed to his home or to the hospital a more permanent dressing should be applied. A good strong flannel bandage should be applied to the chest and fastened with safety pins so that the movement of the ribs is entirely prevented. In the absence of flannel an ordinary linen towel or a piece of firm muslin will answer.

Some surgeons apply adhesive plaster, beginning a few ribs above the injured ones, and apply strips about two inches wide. Overlapping about the third, they carry this dressing below the fractured ribs and thus prevent the movement of the fragments. The flannel bandage will prove more comfortable to the patient than any other dressing.

In some cases there will be a depression of the fragments, and

it will be impossible to elevate them without direct force. A tenaculum passed under the rib and an effort made to elevate by gentle force will as a rule prove successful, so that the operation suggested by some of cutting down and elevating them will not be required. After the bandage is applied the forearm on the affected side should be brought across the chest at a right angle with the arm and held in that position either with a bandage or a sling. The patient should be kept quiet for ten days or longer. It is not absolutely necessary that he be confined to his bed but may select such position as will be most comfortable. Should there be an irritating cough, which is always a source of great annoyance, the best remedy to control it is opium in decided doses. Should pleurisy or pneumonia develop the usual treatment employed in those ailments will be demanded.

#### FRACTURE OF THE STERNUM.

Fracture of this bone is very rarely met with as a result of railway injury, yet occasionally direct violence produces it. The symptoms are those usually incident to fractures, accompanied by a disordered action of the thoracic viscera.

*Diagnosis.*—When a careful examination is made there will be little or no difficulty in making a correct diagnosis.

*Prognosis.*—The prognosis in a simple case is favorable, though the fracture may leave some deformity. When the fracture has been caused by great violence the prognosis should be guarded as the injury may be very severe both to the heart and lungs.

*Treatment.*—This is much the same as that for fractured ribs. The flannel bandage with a small compress on the sternum will prove the most satisfactory. The desired result is to prevent inflammation of the viscera, and aid in the union of the fractured bone.

Should inflammation be developed there is great danger of an abscess forming underneath the bone; but this will generally show itself early and can be opened. In all these cases give



opium to control the pain, and thus relieve the hurried respiration.

#### FRACTURES OF THE SCAPULA.

The scapula is generally broken by a heavy blow directly upon the bone, or by the crushing force, incident to railway collisions where persons are caught in the general wreck of engines and cars with the ever present debris of broken rods, timbers, etc.

A few cases only have come under personal observation. In these cases the injury resulted from the patient having been caught by a moving train and crushed so that the internal viscera were badly injured. When a fracture of this bone is caused by the heavy, crushing machinery of a locomotive, or moving cars, the force necessary to produce the fracture is most likely to cause some serious internal injury.

*Treatment.*—There is no special method of treatment to be given. That which personal experience suggests is to place the arm in a sling and hold it there with bandages, or adhesive plasters, and also adjust the fragments as nearly as possible and apply strong adhesive plasters over the region of the fractured scapula, then apply a good strong body bandage, firmly fastened with safety pins. The bandage is just the same as that used in fractured ribs.

#### FRACTURES OF THE UPPER EXTREMITIES.

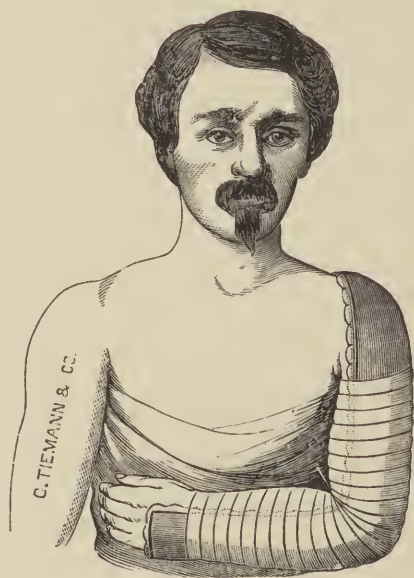
In the great majority of cases of fracture of the upper extremities, from railway accidents, the injury will be so severe as to necessitate amputation, yet in some cases of compound, comminuted fracture, even, the result of the person having been caught by the bumpers or deadwoods, the effort to save the limb has proven successful. When the fracture has been caused by direct violence, as just mentioned, there will always be considerable injury to the soft parts, followed by much swelling, so that in most of these cases it will be with great

difficulty that the exact character of the injury can be determined. It is not so important that the surgeon should know certainly that the fracture is transverse, oblique, serrated or longitudinal, but he should satisfy himself whether the bones are comminuted, and also of the extent of the injury of the soft parts. All fractures occurring in the shaft of the humerus can be easily recognized, and when the injury to the soft parts is not extensive the case is not difficult to treat. I treated a case a few years ago where a young man, twenty years old, in good health, with no constitutional disease, had suffered from a compound, comminuted fracture of the right arm, just above the elbow, the result of being caught between the bumpers. The surgeon who first saw the case decided that amputation was necessary, and I was sent for to make the operation; but after seeing the case and making a careful examination it was decided to make an effort to save the limb for the reason that the soft parts were not severely injured and the circulation was good.

The result was that the patient was discharged from the hospital in less than five weeks, not entirely well of course, but so far recovered that he was able to travel a distance of fourteen miles in the country; and in three months he was able to return to his work with a good arm. The displacement is not always present in fractures of the shaft of the humerus for the reason that the fracture may be serrated, in which event the ends of the fractured bone may be so interlocked as to remain in contact, but in the majority of cases the muscles will draw the fragments out of place, so as to cause quite a deformity.

*Treatment.*—In the treatment of fractures of the humerus much will depend on the extent of the injury to the soft parts. Should there be much swelling, with echymosis, showing that the soft parts have been greatly injured, the best course to pursue is puncture the arm with the needle of a hypodermic syringe or with a sharp pointed bistoury, so that the serum and blood can escape and thus prevent the strangulation of the tissues. To aid in keeping up this flow it is well to envelop the parts with hot cloths; as hot as can be tolerated by the patient.

The carbolizing of the hot water is also recommended. Great care must be exercised in the use of these applications, and the work should always be entrusted to a good cautious nurse who should be carefully instructed by the surgeon in the proper method of application. This treatment should be continued from one to five days, or until the swelling has largely subsided. Should the soft parts be so extensively injured that no firm appliance can be used, as is frequently the case, it is best



to adjust the fragments and envelop the arm in a heavy roll of absorbent cotton and bandages; then more cotton and bandages, so that the soft cotton with the bandages will make a comfortable support for the arm, and aid very much in holding the fragments of the bones in position. A case is now recalled where a prominent surgeon took a pillow of feathers and enveloping the arm with it held it on with a firm bandage. This form of dressing can be used without any danger even in com-

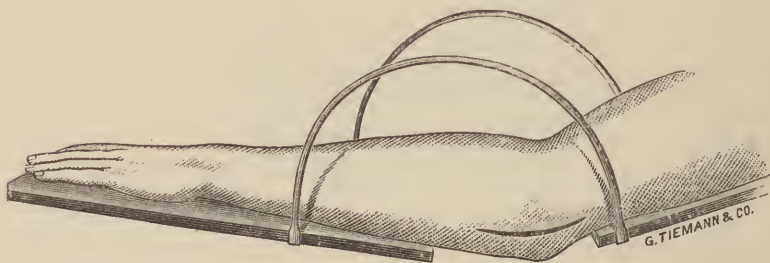
pound fractures if the antiseptic precautions are taken when dressing the broken limb. In cases of compound fractures of the arm the use of the drainage tube with the antiseptic precautions, and a permanent dressing to hold the fragments is always good treatment. When the fracture is a simple one, the ordinary splints of pasteboard, wood, zinc, tin, leather, plaster Paris; or anything having sufficient firmness to hold the parts will be proper. It must be understood that when the fracture is near a joint it is not so easy to hold the fragments in place, and the surgeon should be more careful in the application of his dressing. As bearing upon this interesting subject we make the following extracts from a paper read by Dr. H. C. Howard of Champaign, Ill., at Springfield, April 30, 1884.

"To give a concise history of compound fractures of the arm would be to give the history of each separate case, as no two in any surgeons experience are of the same character, yet the general outline of all have a marked bearing on the treatment. All cases of compound fractures have first to be thoroughly studied before treatment can be instituted. The amount of injury to important vessels and nerves is to be carefully noted. The amount of comminution of the bones is of but minimum importance compared with the destruction of nerves and arteries; with those intact, the bones of the arm and forearm may be in many pieces and yet a fair result be confidently expected. The muscles even may be severed from their attachments to some extent and yet a serviceable arm obtained.

"The most difficult of these fractures which we are called upon to treat, are those at the elbow and its immediate vicinity. Take for example an arm crushed between the deadwoods, likely crosswise, as the arm is most likely to be caught in this position, and what can we expect? Certainly not, in all cases, amputation. That would leave many a man a poor prospect in life with only a short stump, as an assistant; not exsection because with a small fragment of the joint removed a better result would be secured than by its total removal.

"In many of these crushed fractures the arteries and nerves

are found intact, while the bones and fleshy portions are much comminuted, yet we have succeeded in saving many of this class. The same general principle of treatment will apply to these severe cases as to the simple fractures. The general precept in treatment of this class of cases is to control the inflammatory action which will always follow, that only good results shall be obtained. To do this, the temperature must be controlled at the same time that the fragments of bone are kept in position by a properly adjusted splint. Here is the point where most surgeons fail. A properly adjusted splint holds the parts in position without any undue pressure at any one point, and particularly without compressing the already obstructed vessels. No pressure of a splint should, for a moment, be tolerated on the part of a fracture. All necessary support can, as a rule, be obtained on the uninjured portions of the limb, while the compound parts can be left fully exposed for treatment by irrigation. To accomplish this point with a compound fracture of the elbow joint, no splint will answer the purpose so well or fill the indications so perfectly as a splint made of zinc, galvanized iron or some material of like nature,



made by connecting the zinc or galvanized iron with a bent iron rod or wire. The object of this form of splint is apparent to all. You get the support for the arm above the point of fracture, or the humerus; the forearm is supported below the point of injury. Both places of support are at anatomical points where there is little danger of obstructing the circulation and yet leave exposed all the parts which require



watching. This form of splint should always be made to fit the case under treatment, as I have found it as a rule that no splint can be used on a severe case without a modification. Thus every case must have some modification of the splint for adjustment to its particular fracture. Take, for example, a case where there is a crushed fracture of the condyles of the humerus with a complex fracture of the shaft just above the joint, with the fragment protruding on both sides, and usually in front. How are you to dress such? You cannot place a splint over the point of fracture. You cannot use pressure, even with a bandage, to any great extent with safety. Then shape your splint to fit the arm, not the arm to fit the splint. Make the upper portion of the splint short so it shall not touch the fractured part, yet keep enough of the shaft of the humerus under control of the splint to keep the arm in shape. Adjust the forearm to the splint and hold it in position without interference with the fracture, but to hold the arm in a normal position. Then you have complete control of the limb without interference with the circulation and in such a manner that the crushed parts of the limb are in their normal relation with one another. This form of splint, while it fixes the arm perfectly, admits of the application of irrigation, while the moisture has no effect upon the material of the splint; neither causes it to lose its hold upon the parts. Thus you have control of the arm while you are at liberty to apply any treatment to the comminution which you may wish. With me, nothing takes the place of water at a temperature suited to each individual case, some requiring a high temperature, others low.

“CASE I.—Master John S., æt. 2½ years, compound, comminuted fracture at left elbow. Humerus fractured one and one-half inches above the joint, condyles separated, one protruding on the anterior internal side, the other posteriorly. Fracture of the ulna just below articulation, with lower end of upper portion protruding posteriorly; fracture produced by a plank 2x6 falling edgewise on the arm while on the ground. This case was, by several surgeons who saw it, pronounced hopeless and amputation was advised.

"It was found on examination that if the pieces were replaced in position and the forearm semi-flexed, the circulation at the wrist was good, and feeling restored. Finding such to be the condition, an effort to save the arm was decided upon, a splint of the form described was constructed, the arm adjusted, and to-day the young man is in active life as a painter. In this case, after adjustment, the arm was placed upon a straw pillow with a constant stream of water, at a temperature of about 90°, passing over the arm, keeping all parts fully wetted and the temperature normal. This case, occurring at the age of two and one-half years, was again the subject of a fracture of the humerus at about the same parts, at the age of ten years, by being thrown from a horse, and yet by following the same line of treatment the arm is almost perfect in its motion and with only slight enlargement of the articulation. As this case was of a child it cannot be classed as a railroad case, but the following can be called by no other name:

CASE II.—Mr. H., æt. 38 years, conductor; left arm caught between deadwoods of cars in coupling. The left arm was expected to be above the deadwoods, but by a slight slip of the foot it dropped sufficiently to permit the corners of the blocks to catch the elbow and be of such force as to start the cars. The inner condyle was caught, the outer not, producing a compound fracture of the condyle and almost completely crushing it. The artery was found intact with sensation only partial. It was decided to attempt the saving of the arm even at the risk of secondary operation, and likely an ankylosed joint. The case was at once adjusted with a zinc splint in a semi-flexed position, no pressure being used on the point of fracture; the arm placed in a comfortable position on a straw pillow, with the elbow constantly under a stream of warm water, and warm applications to the forearm. This case was of much interest, as several pieces of the condyle were removed at the first dressing, and it was expected that the joint would be ankylosed. But by passive motion of the joint, begun at the end of the second week, the man was able to resume work at the end of three months, and now has a very serviceable



arm, although the motion is not quite so free as normal. In this case the temperature of the water used in irrigation had to be changed several times to suit the varying temperature of the parts under treatment. It was not necessary to wholly remove the splint to obtain motion, but only to loosen the bandages on the forearm. When you have control of the same and yet keep the whole arm in perfect adjustment, you can make use of extension and at the same time rotation, and then restore the arm to its normal position on the splint.

CASE III.—Mr. B., æt. 26 years. Left arm caught in a calender machine. Was caught by the fingers when trying to smooth cloth in the commencement of a roll. The hand being caught, was wound around a four-inch square shaft, breaking some of the phalangeal bones, displacing the carpus, fracturing the radius and ulna in several places. Ulna protruding three inches, tearing a hole in the cloth and protruding the same. Extensor muscles of forearm torn from their attachment near the elbow and crushed between the layers of cloth. Elbow partially dislocated and the soft parts of the arm so badly contused that sloughing followed on one half of its inner surface. Amputation was my first thought, but upon close examination, I found no place short of the shoulder joint where a round flap could be obtained, and to have amputated at the shoulder would have been death in his condition. This arm was dressed by removing all loose pieces of bone. The crushed portion of muscles were carefully pared off and all portions adjusted, as near as possible in the normal position, a splint of galvanized iron made for the case and applied, water of suitable temperature in constant stream to the whole length of the arm, while the arm was resting on a pillow in as comfortable position as was possible, some sloughing followed, but the readjustment of splints, to avoid the sloughing parts, was all the change made. Passive motion was secured after the fourth week. Some loose splinters of bone were at times removed, and at the end of four months the man was able to be about the factory, but with slight ability to extend the fingers, the extensor muscles of the same being pared off in the adjustment of the parts.

In one year after the injury, he had very good use not only of the arm but could use his fingers to good advantage, though not perfectly. In reporting these cases I do not wish to be understood that cases of compound fracture of the arm require amputation or exsection, but many, that are not sacrificed, can, with due care of the surgeon, be saved to make very serviceable arm. Too often the surgeon sees by amputation a quick recovery is at hand and a good looking stump secured the man a cripple, and the surgeon saved time, and the danger of trouble from an imperfect result. Yet with all this before him, is the surgeon justified in the sacrifice of the arm when there is a possibility of recovery even with an imperfect result? Such cases are and will be presented to us, and our best judgment should be exercised for the benefit of the sufferer, and when any reasonable hope exists always to give the patient the benefit of the doubt, although by so doing we take upon ourselves increased responsibility and liability without its proper modicum of remuneration."

The condyles of the humerus are frequently fractured, being much exposed, and in coupling cars, the arm being caught between the deadwoods or bumpers they are almost certain to be broken. When the fracture does not extend into the joint very little treatment is required to secure a good result. Fractures in the joint are of a most serious character and ankylosis either partial or complete may be feared. The arm should be placed on a pillow and hot fomentations applied for several days, when the arm can be slightly flexed and a splint applied to hold it. A splint made of heavy tin or zinc to fit closely on the inner part of the arm, extending nearly to the shoulder and near to the joint; another to be placed on the forearm, made of the same material and both united by a heavy piece of wire so the arm can be flexed and held in this position allowing the elbow to be entirely exposed, will prove a good appliance. In the treatment of fractures of the forearm the same general rules should be observed as in the treatment of other fractures. When both bones are broken the surgeon should endeavor to adjust the fragments and hold them so as not to

interfere with the rotary movements of the hand, and prevent if possible the consolidation of fragments of the radius and ulna, which would of course prevent the rotation of the forearm.

In most of the cases of injury to the forearm, hand and fingers in railway accidents the soft parts are so much contused or lacerated that it will be impossible to apply any splints, and such cases must be treated by laying the fractured limb on pillows and keeping the fragments adjusted as nearly as possible, remembering that even a deformed and crippled arm or hand is far better than none.

#### FRACTURES OF THE VERTEBRAL COLUMN.

Fractures of the vertebral column are very rare compared with the fractures of other bones, but may be produced by violence applied to any point in the length of the spinal column, or by heavy falls upon the feet or hips. In a recent case which occurred at Van Wert, Ohio, on the Pittsburg, Ft. Wayne and Chicago railway, the patient was standing on the track where a freight train, unobserved by him, was backing up, and striking him he was thrown down and rolled along by the cars for some distance, and thrown from the track. When he was picked up it was found that his lower extremities were paralyzed, and there was a fracture of the third and fourth lumbar vertebra. The force producing these injuries is generally so great that they are most frequently complicated with injury to the spinal cord. If any marked displacement occurs the cavity of the spinal cord will be encroached upon and of course any pressure upon this delicate organ will interfere with its function. The symptoms of these fractures will of course vary with the nature and extent of the injury.

Should the body of the vertebra be fractured and complicated, as is usually the case, with a dislocation and consequent pressure on the cord, there will be complete paralysis of the lower extremities and of all other parts below the point of fracture. If the fracture and dislocation be located in the upper

cervical vertebra there will be instant death. When the fracture is lower down there will be paralysis of the lower extremities, constipation of the bowels, with retention of urine, and in a very short time bed sores will manifest themselves and in some cases great sloughs will form.

*Diagnosis.*—In most of the cases there will be but little difficulty in making a correct diagnosis. There may be some difficulty in locating the point of injury owing to the deep muscles, ligaments, and the slight displacement which occurs, but in the great majority of cases there will be but little difficulty in locating the point of injury, and in making a correct diagnosis. There may be a fracture of the spinous process without communicating with the body of the vertebra. In such a case there will be a slight deformity, but the symptoms of paralysis will be wanting, which are always present in case of fracture of the body of the vertebra, with compression of the cord.

*Prognosis.*—When there is a fracture without displacement, the prognosis may be regarded as favorable. Yet even such a case is not free from danger, for the reason that the inflammation necessary to cause the fracture to unite may result in an inflammation of the meninges and also of the cord itself. But the cases where there is complete paralysis of the lower extremities, on account of the fracture and displacement, are always of a very serious nature, and the surgeon should never give a favorable prognosis. The cases may not prove fatal but the paralysis will remain permanently, unless relieved by surgical interference. In making an examination of the spine it is best not to turn the patient on his face for the reason that there is danger of his becoming asphyxiated before the surgeon can see the danger. The examination can as easily be made by having the patient on his side and thus avoiding the danger referred to.

*Treatment.*—Should there be a displacement without fracture, which is not very probable, the treatment to be adopted is to proceed to reduce the luxation. If the case should be complicated with a fracture the treatment will be the same. The

means employed should be extension and counter-extension. One of the best means is the tripod with the suspending apparatus as used in cases of spinal disease when applying the plaster jacket. In suspending a patient great care should be taken not to asphyxiate the patient; and if symptoms of syncope should come on it would be well to have the assistants at hand remove him at once to a bed. If no unfavorable symptoms come on the patient should be suspended for a considerable time and the reduction aided by making extension on the lower extremities by manual manipulations. While the patient is suspended a plaster jacket should be applied extending from down over the hips upward to the axilla so as to give the required support.

By having this properly applied the patient can be changed from one position to another without causing any irritation at the point of fracture or dislocation. When the reduction cannot be effected and the case is complicated with compression of the cord the patient should be kept on a water bed, water or air pads in order to prevent bed sores.

Everything should be scrupulously neat and clean, and the body and limbs frequently bathed. Should the parts exposed to pressure become inflamed it would be well to bathe them with the following solution:

R <sub>x</sub>	Tinct. Arnica,	-	-	-	-	-	5j.
	Acid Carbolic,	-	-	-	-	-	3ij.
	Glycerin,	-	-	-	-	-	3j.
	Aqua Dest.,	-	-	-	-	-	3iij.

M. Sig. Bathe the parts every three hours.

The bladder should be carefully looked after and the urine withdrawn at regular intervals, and not allowed to remain so as to become decomposed, and ammoniacal as it then becomes very irritating. The opinion of Mr. Hutchinson, that it is better to allow it to remain, distending, as it does the bladder, and trusting to the mechanical overflow, is pernicious and dangerous, resulting in serious consequences to the patient, causing inflammation of the bladder and frequently rupture, with infiltration of urine in the soft parts and consequent abscess.



We saw a case of this kind in the Royal Infirmary, at Edinburgh, Scotland, which was indeed, a very serious one. The reason given by Mr. Hutchinson, for this treatment is, that the use of the catheter may cause ulceration. The use of the catheter should always be with great care and gentleness. Prof. Ashhurst says "it should only be done with a flexible instrument used without the stillette." The silver catheter in the hands of a skillful and careful operator, is less liable to do harm than the flexible one which cannot be guided with exactness. There is no doubt there is more harm done by forcing into the bladder a flexible catheter than there would be if a good silver instrument were carefully used.

The application of ice to the bed sores is very objectionable and should never be employed for the reason that it will have a tendency to lower the vitality of the parts, and increase the slough. Always employ stimulating applications such as those named, but never use a depressent. Constitutional treatment may be of benefit in these cases. Some surgeons recommend the administration of belladonna with opium; and a good dose of morphia sulph. with atropia sulph. may be administered hypodermically with good results, but the giving of decided doses of potassia bromide combined with hydrate chloral has been very beneficial in a number of cases. We desire to caution against the use of strychnine and electricity in these cases as they cannot but do great harm. The cord is not weakened by disease but cannot perform its function by reason of the compression, consequently any nerve stimulant at this stage of the injury would only increase the danger, and should not be employed.

#### TREPHINING, OR RESECTION OF THE SPINE.

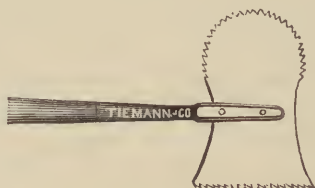
Professor John Ashhurst, Jr., M.D., in his excellent work on surgery, in speaking of this operation, concludes by making the following statement: "Surely we are justified in declaring with Le-Gros Clark, that we cannot regard trephining the spine as brought within the pale of justifiable operations in surgery."



Professor Ashhurst has given this subject much thought, and has furnished the profession with valuable statistics, both in his work on surgery and in his monograph on "Injuries of the Spine," yet we think he is not justified in making the statement that trephining the spine is not a justifiable operation. I see from the statistics of his work on surgery that three of the forty cases reported by him have been relieved, and in five of the cases the result is not given. One of these, the fortieth, and the last reported by the author, in which my name appears as the operator, I have thought it proper to give to the profession the result, and also that of two other cases in which I operated.

The first case, Mr. W. P. Wolcott, a laborer, while engaged in a sand pit, a portion of earth fell upon him while in a stooping position, causing a fracture of the eleventh dorsal vertebra, followed by all the symptoms of compression of the cord, complete paralysis of the lower extremities, both of motion and sensation, constipation, retention of the urine, bed sore, etc. I first saw the patient April 20, 1875, about nine months after the injury had been received. At that time the patient was almost entirely helpless, the symptoms above enumerated, continuing with indigestion, great emaciation, and in every way the object of pity; and I am of the opinion that if Prof. Ashhurst could have seen this case when I first saw it, and could see it now, he would change the statement in his work that the "operation of trephining for the injuries of the spine is not a justifiable one." After examining the case I concluded that an operation was justifiable, and on May 18, 1875, in company with Dr. H. A. Clark, I proceeded to operate by making a free and deep incision, carefully dissecting the soft parts from the bones of the spine, and then making an effort to cut through the laminae of the injured vertebra with the immortal Heys saw, but failed. Perhaps I did not know how to use it, but I never have been able to make any use of this instrument except to fill up my case. I then removed the spinous process with the bone forceps, and used a small trephine, and succeeded in removing the button, and could see the membranes

of the cord which seemed to be in a healthy condition. I then removed the entire arch of the vertebra with the bone forceps. After all hemorrhage had ceased we brought the parts together with a few interrupted sutures and applied a simple water dressing and gave him an anodyne with some potassa bromide. When we visited him on the following day he complained of pain in the region of the bladder and also through the bowels, and in the lower extremities. In a few days after the operation, sensation returned in part to the sphincters and he was able to attend to the calls of nature; also some sensation in the lower extremities and the bed sores healed, and the patient improved in every way, but motion was lost forever.



He has not been able to walk or move his limbs since the operation, so that I am certain there must be some pressure on the anterior portion of the cord, perhaps from a deposit in the reparative process, while the system was repairing the fractured bones. The general health improved at once, and has been good ever since. The patient is still alive and is now serving the people of Van Wert county, Ohio, on his third term as County Recorder.

I wrote him a letter of inquiry last August, asking him to give me a statement of his condition before the operation and since. I received the following reply:

VAN WERT, OHIO, August 8, 1882.

DR. C. B. STEMEN, Fort Wayne Ind.:

DEAR SIR.—Yours of the 7th inst. received. I would like to give you a brief reply, but the questions you ask are such that I cannot answer without making it a little lengthy. The dif-

ference in my condition is so great that I must take some time in explaining.

I had been injured nine months before I saw you, and was reduced to the lowest stage possible for me to live, suffering from a constant fever, bowels constipated, and only moving when taking the strongest purgatives. My mind reduced to a childish simplicity, my back so weak I could not sit up long enough to change my shirt, sphincters unconscious, paralysis perfect below the hip, and this appeared to be moving upwards. I could not move in any way without help. After the operation and healing, as you know all about, I began to improve in mind and body; appetite and digestion good. My bowels became more regular. I could sleep well at night, read and understand it. My back got stronger, so that I could sit up as erect as any one. The relief this afforded me no one can tell. This improvement has continued up to this<sup>a</sup> time. I now use cathartics but seldom, neither have I for four years. The sphincters are conscious nearly to perfection and I now enjoy good health. My legs feel as though they were tied; they pinch and burn me constantly, so much so that it is quite annoying to me at times. The skin appears natural. You ask me whether I have been benefited by the operation. I think I have as much comfort as the average individual; am able to make a good living for myself and family, and enjoy the society of friends and am now able to give as well as receive the comforts that make life bearable. The operation did not bring that complete relief we hoped for, but enough was accomplished to pay for all it cost and I trust I shall never be ungrateful or considered so by those who so kindly aided me. Hoping that this hurried account is what you desire, I am sir,

Yours truly,

W. P. WOLCOTT.

<sup>a</sup> The other case was a gentleman living in Macon county, Mo. I found him eighteen months after the injury. The injury in this case was in the ninth and tenth dorsal vertebra. I made the same operation as in the previous case, only in this I

used the bone forceps made especially for this operation. I removed the two arches of the vertebra above named. After removing the fractured bones, which showed the marks of the fracture, I accidentally touched the cord with the sponge, when involuntary motion of the extremities commenced, and I am sorry to say that this still continues. I do not think that the operation was of any benefit to this unfortunate man. I also wrote to him in August, 1882, and received the following letter:

COLLEGE MOUND, MACON COUNTY, Mo., August 26, 1882.

DR. C. B. STEMEN:

DEAR DOCTOR.—About the operation I can only say that I do not think it was any benefit to me whatever. I am in right good health now considering my condition. I do not eat much but enough to keep me in tolerable flesh. My lower extremities have dwindled until they are very small. Have no control over my bowels or urine. I am very slowly growing weaker in my back, and am in constant pain around my middle, about the line of paralysis. Have been troubled for several years with catarrh of the bladder, which seems to be slowly growing worse. Involuntary motion still continues in my lower extremities.

I would state that it is my opinion that your diagnosis in my case was wrong. It is my opinion that if the operation had been made at the junction of the spinal column and the sacrum it would been nearer right, and been more apt to have relieved me; however, this is only guesswork with me. If I can give you any additional information please let me know, and I will do so with pleasure.

Yours truly and fraternally,

A. R. GAUNT.

On September 8, 1883, we were called to see a case which we found to be a fracture of the tenth dorsal vertebra, the accident occurring 24 days previous. We found the patient with complete paralysis of the lower extremities, without control of the sphincters; bladder distended, urine and feces passing involuntarily, also with very extensive sloughs on the back,

hips and legs. After a careful examination we advised an operation for the relief of the compression, which was consented to by the patient and his friends. The serious nature of the operation was fully explained to the patient and his wife and friends, and the great danger attending all such operations was made known to him several days before the operation was made but he insisted that we give him the benefit of an operation, and his friends consented to it. On September 17, assisted by several of my colleagues and others, we made the operation. After cutting down to the seat of the fracture and dissecting away the soft parts, we found a fracture of the tenth dorsal vertebra, with a depression of the lamina of the arch. We removed the spinous process with the bone forceps, and with a small trephine cut through the arch of the vertebra, and then by the use of the elevator we raised the fractured portion of the bone and, as the post-mortem showed, relieved the compression, but the cord, which had been compressed for twenty-four days, and no doubt had suffered from some inflammatory process, could but very feebly perform its functions. The patient died on the eighth day after the operation. We notice that among the leading surgeons, both in this country and in Europe, especially those who have made the operation; it is regarded as a justifiable procedure, while on the other hand, some good surgeons, and among them our own countryman and able author, Prof. Ashhurst, regard it as not a justifiable operation. But it will be observed that those who oppose it do not speak from experience, yet some have made the study of injuries to the spine a specialty, and their opinions are worthy to be considered. We would not find fault with those who oppose the operation, yet we think the reasons for their opposing it are not well founded. If but one case in a hundred can be benefited, certainly that one case is entitled to receive the relief afforded by the operation. In our own experience our first case was permanently benefited by the operation, and in the patient's own language, "I think I have nearly as much comfort as the average individual, am able to make a good living for myself and family, and enjoy the soci-



ety of friends and am now able to give as well as to receive the comforts that make life bearable." If the teaching of Prof. Ashhurst would have been accepted, this poor unfortunate man would have been compelled to have suffered on and died without the relief given by surgical interference. The second case was, perhaps, not benefited, yet his condition was not made any worse by the operation, and while he claims that he was not benefited, some of his friends think that some relief was afforded by the operation.

The third case died on the eighth day after the operation, but life was not shortened by it, as the patient died from exhaustion. This class of cases is the most deplorable of any coming under the care of the surgeon, and we confess that we feel like doing something to relieve them, even though but a small degree of benefit can be hoped for.

We would repeat what we have stated before, that we believe the operation to be a justifiable one, even if we benefit only a very small per cent of our cases; and for myself I would say that I would not hesitate to operate, either immediately after the injury or as soon as the symptoms of active inflammation had subsided. I desire in closing this paper to make special mention of the support given me in all these cases by leading members of the profession. The operation is a difficult one and no surgeon should undertake it unless he has first skilled his hand on the cadaver. In my first case I was greatly assisted in the post-mortem room of the Cincinnati Hospital by Prof. P. S. Conner, M.D., of the Medical College of Ohio, and other members of the Faculty of this College.

The following table, giving valuable information on this subject, is copied from Prof. Ashhurst's work on surgery, except the last three cases, which are added by the author, who was the operator:



## CASES OF RESECTION OF THE SPINE.

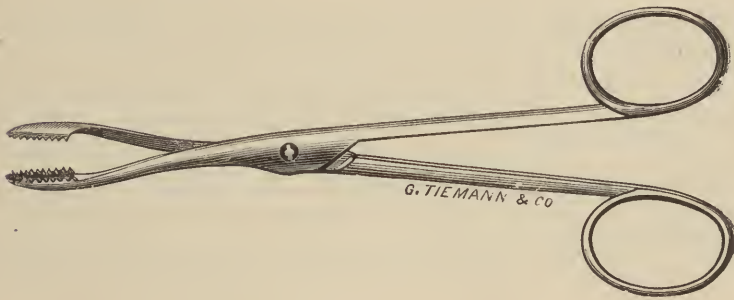
<i>No.</i>	<i>Result.</i>	<i>Operator's Name.</i>	<i>Reference.</i>
1	Died.	Cline, Sr.	Chelius' Surgery; ed. by South, i, 590.
2	Died.	Wickham.	Lancet, 1827.
3	Died.	Oldknow.	Hutchison, in Am. Med. Times, 1861.
4	Died.	Tyrrell.	Malgaigne, Fractures et Luxations, i, 425.
5	Died.	Id.	Ibid.
6	Died.	Barton.	Malgaigne, (Ackard's Translation), p. 343.
7	Died.	Boyer.	Heyfelder, Traite des Resections (trad. par Boeckel), p. 224.
8	Died.	D. L. Rogers.	Am. Jour. Med. Sciences, O. S., vol. xvi.
9	Died.	Attenburrow.	Chelius and Heyfelder, op. cit.
10	Died.	Laugier.	Malgaigne, op. cit.
11	Died.	Holscher.	Brown-Sequard, Central Nervous System, p. 256.
12	Relieved.	A. G. Smith.	N. A. Med. and Surg. Jour., vol. viii, p. 94.
13	Died.	Mayer.	Heyfelder, op. cit.
14	Died.	South.	Notes to Chelius, vol. i, p. 591, etc.
15	Died.	Blackman.	Hutchison, loc. cit.
16		Edwards.	Brit. and For. Med. Review, 1883.
17		Blair.	Ballingall, apud Hutchison, loc. cit.
18		Goldsmith.	Gross' Surgery, 2d. edit., vol. i.
19	Died.	Stephen Smith.	Hutchison, loc. cit.
20	Died.	Hutchison.	Ibid.
21	Died.	G. M. Jones.	Brown-Sequard, op. cit., p. 255.
22	Died.	H. A. Potter.	Hurd, N. Y. Jour. Med. 1845.

## CASES OF RESECTION OF THE SPINE—CONTINUED.

<i>No.</i>	<i>Result.</i>	<i>Operator's Name.</i>	<i>Reference.</i>
23	Died	Id.	Am. Jour. of Med. Sciences, n.s., vol. xlv.
24	Not improved.	Id.	Ibid.
25	Died.	R. McDonnell.	Ibid, vol. i.
26	Relieved.	Sam. Gordon.	Med.-Chir. Trans., vol. xlix, p. 21.
27	Died.	Tillaux.	Brit. and For. Med.-Chir. Review, 1886.
28	Died.	Willet.	Med. Times & Gaz., Feb. 2, 1867, and St. Barth Hosp. Rep., vol. ii, p. 242.
29		H. J. Tyrrell.	Dub. Quart. Jour. of Med. Sci., August, 1866.
30	Died.	Maunder.	Med. Times and Gazette, Feb. 23, 1867.
31	Not improved.	Eve.	Am. Jour. Med. Sciences, n.s., vol. lvi.
32	Died.	Cheever.	Boston City Hosp. Reports, 1870, p. 577.
33	Died.	Id.	Ibid, p. 580.
34	Died.		St. Bartholomew's Hosp. Reports, vol. vi.
35	Died.	Nunneley.	Med. Times and Gaz., Aug 7, 1869.
36	Died.	Id.	Ibid.
37	Died.	Id.	Ibid.
38	Relieved.	Id.	Ibid.
39	Died.	Willard.	Am. Jour. of Med. Sciences, n.s., vol. lxiii.
40		Stemen.	Clark, Clinic, June 5, apud Mon. Abst. Med. Sci., August, 1875.
41	Relieved.	Id.	Clinic, Cincinnati, Ohio, Dec., 1875.
42	Died.	Id.	Fort Wayne, Ind., Jour. Med. Sci., October, 1884.
43	Died.	McGavern & Stemen.	

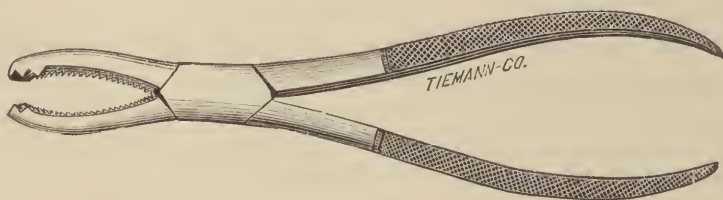
Prof. Ashhurst says: "Considering, therefore, the not infrequent favorable issue of these cases under the expectant treatment and in view of the fact that the mortality after the operation has been 85 % of terminated cases, and that no well authenticated instance of complete recovery after its employment has yet been recorded, surely we are justified in declaring with LeGros Clark that we cannot regard trephining of the spine as brought within the pale of justifiable operations in surgery."

While I have no desire to disagree with the very learned and able surgeon, who has given the subject much thought, yet I believe the operation to be a justifiable one. The condition of the patient cannot be made any worse. Nor is the operation a dangerous one. If skillfully made it will not hazard



the life of the patient in the least. The best time for the operation is immediately after the injury has been received, and before any inflammatory changes occur. Remove the pressure from the cord as soon as possible and if it has not suffered a laceration it will again be restored to its normal function. The reason for a failure of good result in most of the cases given in the above table is found in the fact that they were not operated on until many months had passed after the injury was received. Operate at once after the nature of the injury is fully ascertained. The operation is of course a delicate one and requires great care, but it is not as difficult as it is supposed to be by many surgeons.

The best method is to have the patient lying on the side and fully under the influence of ether; then make a long and deep incision dissecting the soft parts carefully from the bones, clamping the bleeding vessels with the Spencer Wells forceps, and if necessary tie the arteries so that before opening the vertebral canal, all bleeding is arrested. This operation should never be undertaken unless there are at least two if not four



good assistants present; one to administer the anesthetic, another to retract the soft parts, and still another to sponge and hand the instruments. After all bleeding is stopped the next step is to remove the pressure or raise the depressed vertebra. This can sometimes be done by grasping the spinous process with the strong, lion-jawed forceps, while extension and counter extension is made by some strong men taking hold of the patient under the arms and lower extremities and thus while



they are making the extension and counter extension, the surgeon with the forceps can elevate the depressed vertebra. Should this mode of procedure fail, the next step is to remove the arch of the vertebra. To accomplish this the best method is to cut away, with bone pliers, the spinous process of the depressed vertebra and then place a small trephine, and cut down with great care through the laminæ, then remove the button

and endeavor to replace with the ordinary elevator. Should this fail, the next step in the operation is to proceed to remove the arch of the vertebra by cutting with the bone forceps. This must be done with great care so as not to injure the spinal cord. The operator must not be in great haste in such a case but must take time and proceed slowly. The operation is somewhat difficult when the patient is very muscular, but with such a patient the operator should make his incisions quite long so he can have abundant room to operate in removing the arch of vertebra. After the fractured bones have been replaced and the pressure taken from the cord, the soft parts should be replaced and dressed antiseptically just as any other incised wound is treated. A plaster-of-Paris jacket should be applied if possible, but when this cannot be done the patient should be placed on a good hair mattress and kept perfectly quiet, or as nearly so as possible, for several weeks. The administration of potassa bromide and chloral, with some belladonna, is always proper in these cases. After the operation, the bladder should be carefully looked after for the reason that from the great distension which sometimes takes place in these cases, the muscular coat has lost its power of contraction, and the patient is unable to void his urine for several weeks after the function of the spinal cord has been restored. The same is true of the bowels, and it will be quite necessary for the surgeon to pay attention to the moving of the bowels by the use of enemas, as this is far better than the administration of large doses of cathartic medicine. If surgeons will carefully study these cases and prepare to operate early, many lives may be saved; and while it is not only a justifiable procedure it would seem imperative that every competent surgeon, in the interest of humanity, should give this class of unfortunate sufferers the benefit of an operation.

#### FRACTURE OF THE PELVIC BONES.

Fractures of the pelvic bones are the result of great violence, and are frequently met with in railroad accidents. It can be



readily understood how a person caught by a "cow-catcher," or shoved along the track by the trucks of a car might receive a fracture of the bones of the pelvis. Frof. Gross, in his "System of Surgery," Vol. I, p. 914, says:

The most frightful accidents of this kind that have come under my observation have been the result of railway injury caused by the body being jammed in between a car and a wall, literally crushing the bones and fatally implicating the bladder and other organs. A number of cases of pelvic fractures have been encountered in the practice of the writer. One, a young man, *æt.* 24 years, in making a coupling, was caught between the deadwoods, about the hips and pelvic bones, and literally crushed. The lower extremities were paralyzed and the patient died in a few hours after the injury was received.

Another case was a young lady, who, in crossing the railroad tracks passed between two cars standing on a side track, and just as she was between them a switch engine came up and drove the cars together, jamming her body between them and causing a fracture of the pelvic bones. It has never been understood how the deadwoods or drawbars could have caught her so as to have caused the fracture of the bones, but nevertheless the bones were broken and she died the same day from shock.

Still another case was that of a conductor on the Wabash, St. Louis & Pacific Railway, who was caught by a car wheel and shoved or rolled along the platform for some distance causing a fracture of the upper third of the left femur, and also crushing the pelvic bones. In this case the patient was brought some distance in a caboose and then removed in an ordinary express wagon a distance of at least six squares to his home, where it was found that his injuries were as above stated. The bones were adjusted and held in place by a firm bandage around the hips, and the fractured femur was held by extension and counter extension and sand bags. The patient was kept quiet by giving him decided doses of morphia and atropia hypodermically. The patient recovered and is now



able to walk and attend to business without the use of a staff. Although he has not, since his injury, taken a train, he is filling a clerical position in the office of the company. The fractures of these bones are always produced by such violence that the force necessary to produce a fracture will, in most cases, cause serious injury to the internal organs, and if the patient survives the first shock there is a liability of some inflammation following which may result in pelvic abscess and in this way exhaust the vital forces, terminating in the death of the patient. There is also, as a rule, severe injury to the soft parts, so that there will be extensive contusions, and sometimes lacerations. One important point in all of these cases is that the urine will be retained, and in some cases the bladder may be ruptured, resulting in the infiltration of urine through the soft parts. These cases are generally of a serious nature, and the surgeon should be guarded in his prognosis. "Of 65 cases of fracture of the pelvic bones analyzed by Dr. J. W. Lyon, 41 recovered and 24 died, one-half of the latter having labored under rupture of the bladder."

In regard to the treatment of these cases no specific rule or method can be given, only to endeavor to reduce the fracture and hold the parts in their proper relation.

Many appliances have been suggested and employed, some physicians advocating the use of the plaster Paris dressing and others the use of a firm body bandage with compresses.

The bones are not liable to become displaced and it will require but little mechanical support to retain them in position, but in all cases the utmost quietude must be enjoined.

The patient must lie on his back, his shoulders elevated. Should inflammation come on the treatment must be directed energetically to its arrest, but not, as recommended by many of the older authors, by active purgatives and enemata. Instead of these give opium and do not disturb the bowels. Give rest to these parts and treat the same as in inflammation of any other parts or organs.

Dr. H. B. Brown, of Lincoln, Ill., read a paper at Springfield, April 30, 1884, of which we make the following extract:

"Ordinarily, simple and uncomplicated fracture of the pelvic bones unite readily and directly, as illustrated by numerous reported cases. Sir Astly Cooper reports two cases of fracture of the pubis, not accompanied by injury to the bladder or urethra, which resulted in complete recovery. In the second case recovery was complete in eight weeks, and the patient could walk nearly as well as before he was injured. He soon after died of some other disease, and the autopsy revealed the os-pubis broken in three places; a fracture in two directions through the acetabulum, also a comminuted fracture of the ilium with great displacement. Hamilton reports a number of cases of simple fracture of the ilium where the recovery was rapid and complete. Two cases are reported from the Massachusetts General Hospital, one a compound fracture of the ilium, from which some pieces of bone were removed, the other, the ilium and the ascending ramus of the pubis; in both the recoveries were good. But when these cases are complicated with injury to the bladder, urethra or peritoneum, as is frequently the case, the results are very different, and recovery is the exception and not the rule. The ease with which fractures of the pelvic bones are diagnosed, differs about as much as the severity of the injuries; and much care and judgment must be exercised in the examination of these cases. First the character and direction of the force must be inquired into. We know that most generally they follow some crushing force about the hips, as a heavy weight falling upon them, or a wagon passing over the body at this point; or, as railway surgeons, that our patients have been caught between two cars, or a piece of timber and a car, while attempting to make a coupling.

Here the pelvis receives the full force of the pressure, and fracture is most likely to occur; then there would follow an inability to rise or walk, unless it involve only a small portion of the crest of the ilium, which symptom Travers has claimed to be diagnostic of a fracture through the acetabulum; but while it may be true that a man with a fracture through the acetabulum cannot stand or walk, surely he would be less able to do so were the ischium or pubes broken.

Crepitus, the chief positive sign of fracture, is sometimes easily obtained; this is more especially true in fracture of the ilium than of the ischum or pubis. The two latter bones, situated as they are, partly imbedded in thick fleshy muscles, make any manipulation of them quite difficult. Hamilton cites a case as reported by Dr. Clark, of Massachusetts, in which the ischum and pubis were broken in three places, as revealed by the autopsy, yet no crepitus could be obtained in the examination. When direct examination of the bones fails to reveal this important sign, manipulation of the thighs often aids us very materially in its production. With these few remarks I wish to report the following case, not that there is anything unusually new about it, but it will add one to the number of a very interesting class of cases: W. D. Plimpton, æt. 38 years; occupation, a bridge carpenter; strong, healthy man. On March 23, 1880, I was called to see this man, who, I was informed, had been caught, while attempting to couple cars, between the projecting end of a large timber which was lying on one car, and another car. He was held in this vise for at least one minute before he could be released; when he immediately fell to the ground, being unable to stand. After conveying him to a suitable place and removing his clothing, I found the blow was received just below the crest of the ilium, which was bruised over quite a surface, and the skin knocked off to a like extent. Rotation of the thigh was good but quite painful; the legs were of the same length but the foot and toes of the right leg were everted; they could be placed in their natural position but if left alone would turn out again, and the patient said he felt much more comfortable when the legs were in their natural position; complained of a great deal of pain in and about the left sacro-iliac region; when we attempted to move him in bed he said it felt like his backbone would come loose from the pelvis. While manipulating the right thigh I felt a distinct and coarse crepitation as though there had been a large surface of fractured bone slipped upon itself. This was the only way by which crepitus could be elicited. Pressure on the ilium and pubis was quite painful but failed to produce crepitation.

Measuring from the anterior spinous process of the ilium to the spine of the pubis, I find it three-fourths of an inch less on the right than on the left side, the fracture evidently existing between these two points, although no distinct line could be determined. My impression at that time was that the break was in the ilium and involving the acetabulum, but, as the patient recovered, I cannot furnish you with its exact course. A bandage was applied around the hips and thorax, and he was placed in a good position and morphia administered. On the day following he complained of a great deal of pain across his bowels and back; his knees were tied together, but from the intense suffering had to be released; passed his urine often, but it contained no blood; placed the leg in a straight line and applied Buck's extension with a two-pound weight, which assisted very much in keeping it in a natural position; but still there was some inclination of the toes to turn out. After six days the patient was removed to his home in Urbana; first applying a long splint to maintain as well as possible the natural and most comfortable position. The reports that came to me after this indicated some peritonitis, and his life was despaired of for a number of days.

"On June 17 following the patient came to see me from Danville; with the use of a cane he could walk slowly, without limping; still had some pain and tenderness on the left side, also pain upon deep pressure upon the right ilium; the anterior portion of the crest of the ilium is fully an inch lower upon the right than upon the left side; some difficulty of flexing the right thigh upon the abdomen. He has called to see me a number of times since, and when I last saw him he was a strong man again."

#### FRACTURE OF THE FEMUR.

The fracture of this bone is frequently met with in railway accidents. In quite a number of instances trainmen, jumping from their trains to save themselves from impending danger, have received a fracture of the femur. It is often the result

also of direct violence, as when a person is caught by a truck, or car wheel, or jammed between cars or timbers in a wreck. When occasioned by direct force the limb is generally crushed and the soft parts severely injured and contused, so that the case presents serious complications.

No attempt will be made to give the different forms of fractures of this bone, as is generally given in our text-books on surgery, but only to speak of all fractures of this bone in a general way. The most common form met with among railway employes is that produced by direct force, where the bone may be broken either in its shaft or neck. Cases where the fracture has been caused by indirect force, such as jumping from a moving train or in falling from a height, there will not be so much injury to the soft parts, and as a rule these cases do better and are more easily managed than when the fracture has been caused by direct force. In a majority of cases of fracture of the femur in railway accidents by direct force the fracture will be found to be compound comminuted, and complicated with serious and extensive contusions, entirely destroying the vitality of the soft parts.

There is but little chance to save a limb when the fracture has been caused by a heavy car or engine wheel passing over it, or when the limb has been caught between the deadwoods or among the broken timbers in a collision or derailment of trains. The severe crushing devitalizes the soft parts, and it is in this class of cases that the surgeon must be exceedingly careful in his examination. No excuse can be made for a surgeon who neglects to make a most thorough examination of these, and in fact of all cases of injury, but more especially where a limb has been injured by direct violence. Several points of investigation are necessary. One very important point is to ascertain whether the arteries are injured to such an extent as to prevent them from carrying a sufficient amount of blood to the injured parts. This is especially important for the reason that in many cases, even where there is extensive contusion and laceration, if the arteries are not injured the limb may be saved, even though extensive sloughing follow the in-



jury. Many cases have been successfully treated and the limb saved which would have been entirely hopeless had it not been that the arteries were intact and in a healthy condition, amply able to carry the blood necessary in the restorative process. Since the introduction of the antiseptic treatment in surgical cases and practice many limbs are saved which under former methods of treatment would have been sacrificed.

Another point of great importance in the investigation of these cases is the general health of the patient; whether he has any constitutional disease such as syphilis, scrofula, or tuberculosis. These have much to do with the success of the treatment, as do also the habits of the patient. A person who has been a "beer guzzler," or has been intemperate in the use of intoxicating drinks, will not do as well as if his habits had been strictly temperate. It is therefore highly important that the surgeon should carefully consider all of these points, as they will have much to do in the final result. The treatment of these cases requires great skill and careful management.

As a valuable contribution upon this subject the following paper, prepared by Dr. William Scott, of Kokomo, Ind., is inserted:

*Compound Fractures of the Lower Extremities.*—A compound fracture is an injury that always creates more or less anxiety in the mind of the surgeon. But when the injury has been produced by a railway accident and the parts are lacerated by having come in contact with heavy timbers, cars, wheels or any heavy moving body, it is certainly to be regarded as more serious than an injury produced by falling and parts coming in contact with some fixed, solid substance, the force no greater than the weight of the body. The difference is as great as that which exists between the latter injury and a simple fracture, or between a subcutaneous and an open wound. In the former, injury we have the shock, as well as the parts lacerated to such an extent that sloughing with all of its accompanying evils is liable to follow. In compound fractures it is the external influences that come in contact with the wound that is one of the elements of danger. In preparing this paper, I have been



obliged to notice the doctrines taught by some eminent writers. I have tried to quote their opinions fairly. The great danger of wounds of the character we are discussing has been noticed by the oldest practitioners of surgery. Although the fact has been so long known and admitted by all writers on this subject, until recently no satisfactory explanation of the cause of the danger has been given. An occurrence so frequent and so interesting as the complications that are liable to arise in compound fractures could not fail to attract the attention of pathologists of the highest order, and men whose scientific attainments entitle them to credit. But you find in their productions on violent inflammations of lacerated wounds, erysipelas, pyæmia, gangrene, or septicæmia, every surgeon has embraced that which accident, prejudice or reflection has inclined to adopt to his theory. However different the opinions of pathologists and surgeons have been as to the treatment of lacerated wounds, all the old surgeons agreed that air had an injurious effect when it came in contact with wounds. Sir Charles Bell, Hunter, Albernethy, all of their age, recognized the deleterious effect of air. The generally received opinion then was that it was the temperature of the atmosphere that excited inflammation, as the temperature of the body is always considerably above that of the surrounding atmosphere. Whenever a direct communication is made between a wound and the external air a reduction of the temperature must be the consequence, and sudden changes of temperature, they claimed, was a predisposing cause of inflammation. As the old writers maintained in their day that it was the external influences that produced the complications that arise in lacerated wounds, we, their followers, admit. But what are these exciting causes? Late experiments seem to prove that it is not air, as decomposition does not take place in pure air; but it is the organic matter that floats in the air that is giving us the trouble. If the surgeon had the means of magnifying and analyzing the particles of matter that are continuously passing into the wounds that he dresses, he would not be amazed at his cases of septicæmia, erysipelas and pyæmia that follow his prac-

tice. The wound not only suffers from mechanical irritation produced by these atoms of dust, but it is the opinion of a large per cent of the profession that these particles of organic matter carry disease with them. The germ theory of disease as taught by Madagan is that many diseases are due to the presence and propagation in the system of minute organisms having no share in its normal economy, and the air is the agent by which they originally reach the system.

If we can rely on what they teach we have to admit that certain forms of micrococci and bacteria exist in all infectious diseases; and they are certainly to be found in every case. Madagan claims that the micrococci have different atoms in different diseases; but their physical characters and grouping as well as their local action classifies them sufficiently to constitute them a distinct species, each having a specific action, as producing a special form of disease, whether it be erysipelas, pyemia, septicemia or gangrene. What is there in a compound fracture that makes it more serious than a simple fracture? but the decomposition of the soft parts that are destroyed, and the absorption of the products of the decomposed tissue, which is facilitated by the presence of an open medullary canal, be one of the above named complications—we know that septicemia or pyemia are liable to occur, and we cannot associate such symptoms with external influences only as the result of the organisms that have been allowed to come in contact with the wounds, producing fermentation, followed by putrification, with the absorption into the blood of the septic matter.

In erysipelas we have a disease that is contagious, and results from the reception into the blood of a poison from without. In traumatic erysipelas the poison has to be introduced into the wound or blood before it is possible for the complication to arise. The morbid anatomy of the local lesion of erysipelas has been carefully studied by Orth, Lukomsky and Von Kecklinhouser. The result of their observations is to show that the erysipelatous process is invariably associated with the presence of micrococci. In the inflamed tissue and the

blood, Orth found that the infiltrated liquid of the swollen parts contained an enormous number of bacteria.

In hospital gangrene it is hard to conceive how any one who has watched its spread from ward to ward could claim anything else than that it was organisms carried from wound to wound by the atmosphere; and to arrest the disease we must destroy the germs that are thus conveyed. Every surgeon has drawn off pus from abscesses that was free from putrefaction, was apparently healthy, without odor. But at the second dressing the fluid discharged as a rule is not healthy, and we will find active putrefaction going on in the cavity. I am convinced that this decay is caused by minute organisms or particles of matter that were conveyed to the cavity from without. It is a well known assumption in surgery that a wound made in a healthy person will heal if placed in a favorable position for repair, and not interfered with. When repair does not go on kindly it is to be presumed that there is something in the nature of the wound or in the surroundings that is retarding the process of healing. The first step in a compound fracture is to ascertain the extent of the injury. If large vessels and nerves are injured the question at once arises as to the propriety of trying to save the limb. In fractures involving the knee joint, before antiseptic surgery was introduced and understood by all surgeons, it was considered the safest to amputate. I see one surgeon in the Russian army reports eighteen cases of gunshot wounds on the knee-joint treated antiseptically with only three deaths. It is only recently in fractures involving the ankle joint, where there was a direct opening into the cavity, that the authors on surgery would sustain us in a conservative course of treatment, but now we are expected to save the limb. If we have to amputate I would operate without delay, avoiding one shock if possible. If we decide to save the limb the next step is to cleanse the wound, and there is nothing in my opinion equal to hot water. I have been using hot water in all my lacerated wounds since it was introduced as a dressing and I am well pleased with it. I cause a continuous stream of water as hot as I can bear my

hand in to be thrown into the wound, continuing to irrigate the parts until all hemorrhage and oozing of blood has ceased, at the same time using a continuous spray of  $2\frac{1}{2}$  per cent solution of carbolic acid on and about the parts. I think the 20 per cent solution is good to use if it does not come in direct contact with the wound. Some claim that nothing less will destroy the germs of disease. I think it acts as an irritant and excites unnecessary suppuration of the parts. While the assistant is applying the hot water and using the spray, I would reduce the fracture and remove all foreign bodies from the wound, shaving and cleansing the surface of the limb; then the wound should be adjusted, bringing the parts together, removing all tissues with the scissors that is destroyed to an extent that sloughing is inevitable. Then the wound in the lower extremities should be antiseptically sealed, using the antiseptic lint or cotton to the oiled silk over this dressing, fastening the edges of the surface of the limb with collodion, no drainage nor provision necessary for it at this dressing. As far back as Sir Charles Bell's writing, he recommended this method of dressing wounds, not assigning the same reason that we do for the treatment, but he called it a smothering mode of treating wounds, stating in support of his method that he had noticed that wounds healed more kindly under a scab. When nature fails or has not time to furnish the covering, it is now expected of the surgeon. After a compound fracture has been dressed, it becomes a question with some as to when it should be redressed, and some of the authorities fix a definite time for redressing. When a fractured limb is painful or the patient complains of the dressing or that the limb is not resting, or if there is any evidence of hemorrhage or a discharge of any kind it should be dressed without delay. If I succeed in getting my first dressing well applied, and there is no swelling or evidence of suppuration, I would not disturb until there was some demand for it. At each subsequent dressing follow up the plan of treatment adopted, applying to the wound stimulants if necessary. I have been well pleased with the rapid repair of tissue under this mode of dressing, and surprised at

the small amount of suppuration and sloughing; and the fractures have, with rare exceptions, united as readily as simple fractures. Immobility, so essential to the success of a fracture, is best obtained, in my opinion, with a fracture box, hinges to the sides, bran placed for the limb to rest on, and sand bags for compresses, using cotton, wool or whatever suits best that is soft and warm to keep the foot and limb in proper position. The patient will rest better and be better satisfied if the limb is placed in a swinging position, when it can be done, but we have to treat every case on its own merits, as has been said by some one, generalizing our treatment and individualizing our cases. I have long used the plaster of Paris splint in the treatment of fractures, and now that Stimpson has adopted a plan by which we can apply the anterior or posterior splint, to suit the wound, and remove and apply at each dressing, I intend going prepared to apply, if desirable, carrying the shellac and paraffine, as he uses it to protect the splint and prevent the discharges from saturating it. I have long been convinced of the efficacy of quinine in arresting fermentation. In all my cases, before complication arises, I have been in the habit of giving quinine in from three to four grain doses, alternated with muriated tincture of iron, in doses suited to the stomach of the patient. A great many will not bear large doses of quinine or iron following an injury. I could report several cases of compound fractures successfully treated in this way, in some of which the question was raised as to the propriety of trying to save the limb. One especially, a railway accident; the subject, a man æt. 60 years; a compound comminuted fracture of the ankle joint. He now walks without a cane. But it is unnecessary to report cases to a body of surgeons that have met to discuss principles in surgery. I am not one of those who believe that every case that makes a good recovery entitles the surgeon to credit, nor does it establish the merits of a mode of dressing. We have some remarkable cases with very unfavorable treatment, some bad results with the best of treatment. Every surgeon must have confidence in some particular treatment, and believe in his plan of dressing, then enforce



it. While one class claims that air is deleterious, we have such men as Teal, Humphreys and J. Y. Simpson recommending the air dressing. While James R. Wood was a believer in microscopic organisms floating in the air, he also believed that their deleterious effect could be sufficiently overcome by frequent washing with carbolized water. While the different systems are so unlike, and the advocates of each method refer to their clinical experience to prove their success, it leads to this conclusion: that modern scientists have it to settle, and the germ theory of disease will finally decide the best method of arresting the complications that arise in lacerated wounds if it succeeds in doing what its advocates claim for it."



## CHAPTER VII.

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### AMPUTATIONS.

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The term, amputation, is employed at the present time to denote the operation of cutting off any part of a limb. It formerly included the removal of the mammary gland and the extirpation of the lower jaw. But it is now restricted to the operation of cutting off and removing any part or the whole of a limb. Some surgical writers speak of amputation as "the last resource of surgery" and as a disgrace to our noble art. This declaration is not generally endorsed by representative members of the profession. It is only when a limb is unnecessarily removed that the surgeon should be stigmatized by the profession and the public. Under the improved methods of treating wounds and injuries, amputations are not as frequently made as under the old method of treatment, and many limbs are now saved that would formerly have been sacrificed. In no other other department of practice has there been so much improvement as in the treatment of wounds; and especially is this true in the management of railway injuries. The surgeons employed by the corporations are among the leading men in the profession, and have given especial attention to this subject. Consequently, great advancement has been made in this department of surgery.

But there are many accidents which are of necessity serious; injuries which no human skill can repair or remedy, and amputation must be made. What surgeon can save a limb which

has been crushed and mangled under the wheels of a railway car or engine, or caught between the deadwoods? Only those who have had experience in the management of these cases know how serious they are and how little hope there is of saving the limb thus mangled. It is not deemed in the least humiliating to the surgeon in such cases to resort to the knife, and instead of imputing blame there should be a sense of gratefulness for the assistance which he affords in relieving suffering and prolonging life. It is in these cases particularly that the great value of operative procedure should be appreciated. If it were not for the prompt and skillful interference of the surgeon in the removal of the limb, the patient would be doomed to a miserable death, after days and sometimes weeks of intense suffering. Gangrene would soon develop and the great mass of devitalized tissue would slough; the open-mouthed vessels would take up the poisonous fluids from the decomposing tissues and carry them into the general circulation, thereby poisoning the entire system and the patient would die. While it is a serious matter to lose a limb it is more serious to die, and certainly there are but few who would not prefer to lose a limb rather than life. Especially is this true since the manufacture of artificial limbs has reached such perfection that in many cases where one or both limbs have been removed the individual can walk nearly as well with the aid of the artificial limbs as he could with the natural members. No good conscientious surgeon will ever remove a limb unless he is satisfied that it cannot be saved. If he is not certain, from the amount of experience he has had in the management of these cases he should call to his assistance good and wise counsel, such as is within his reach. But if he is left to his own resources he should give the case his best judgment and skill.

Dr. Gross says: "I know of no operation which I approach with so much reluctance as the amputation of a limb, or one which gives me more pain." But when a limb is crushed and mangled by a heavy moving railway train there is no other alternative, and the judicious surgeon will at once remove the

limb, as the tissues are necessarily devitalized and cannot be saved even under the most improved methods of antiseptic dressing and treatment.

There can be no humiliation to the surgeon in this procedure, and it will be to the best advantage of the patient, reflecting credit also on the "art and science of surgery."

Agnew says: "In general it may be said that amputation is proper whenever the injury of a part is such as to render it highly probable that without the operation the limb must be lost, or when the patient's life would be subject to greater risk by the adoption of any other treatment, such as resection or expectancy. That persons recover occasionally, from wounds of the most extensive and apparently hopeless character without operation is true, but such very exceptional cases are not to influence the judgment of the surgeon when deciding upon the propriety of an amputation in any given case. I remember an instance in the Pennsylvania Hospital, of a patient with a crushed ankle, who absolutely refused to have the part removed, although the indications for the operation were so clear as to admit of no doubt whatever, and yet after a long and tedious illness he finally recovered with a distorted ankle and useless foot. The result, however, was the loss of the lives of three other patients who encouraged by the obstinacy of this man declined operation, which had they been performed would in all probability have been successful."

A few years ago a patient was placed in the St. Joseph Hospital, of Fort Wayne, Ind., with a compound dislocation of the ankle, the laceration being very extensive and the tibia protruding at least 4 inches, the end of which was covered with gravel and cinders, the fibula being fractured. The patient, *æt.* 55 years, had confirmed habits of intemperance, having been a habitual inebriate for many years. The writer advised amputation, but the patient absolutely refused. His family physician, Dr. J. M. Dinnen, was called and in consultation he also advised that amputation be made, but the patient would not consent.

An excision of the end of the bone was made, the disloca-

tion reduced and the wound dressed antiseptically; but the patient passed into the hands of the county hospital for the poor, and after a long time he was able to leave the hospital with a diseased foot.

While he so far recovered as to move about, an artificial limb would have been more serviceable. These cases are the exception to the rule, and are not to be taken into consideration when deciding upon the propriety of an amputation in cases of severe injury.

It is not only the saving of an injured limb, which should influence a surgeon in making his decision, but the future condition of the limb. A diseased ankle, with ankylosis of the joint, so as to give pain at every movement or attempt to walk, is much more to be avoided than the removal of the part in the first place. Cases are known to the author where the patient would not submit to an operation, and where the attending surgeon claimed a great victory in having saved the limb, when other surgeons had advised removal. In each of these cases the patient remained a great sufferer all through life, unable to walk without pain. There is a misguided conservatism in attempting to save limbs that should be removed, which dooms the patient to a life of suffering by having a useless and painful limb.

Dr. Agnew says on this point: "A damaged finger may, by an unwise conservatism, be saved immovably fixed, either in a state of extreme extension or flexion; but the hand would have been much better and far more useful had the unfortunate digit been cut off."

When there are severe injuries to the soft parts, such as crushing of the muscles, nerves and blood vessels, the tearing away from the bone the periosteum, although the bone itself may not be injured, the limb should be amputated, for in such cases traumatic gangrene is sure to follow and endanger the life of the patient. No hope of saving the limb can be entertained in such a case, and immediate operative procedure should be had, or, as is taught by many surgeons, as soon as reaction may be established. When the bones are involved

as they most frequently are in railway injuries, the soft parts lacerated or crushed into a pulp, the blood vessels and nerves torn, the knife is the only resort.

In many cases the surgeon is called to see the patient under the most unfavorable circumstances; frequently out on the line of the railway where no conveniences can be arranged for the comfort of the unfortunate sufferer. The surgeon, thus situated, must render temporary relief, and can only hastily and temporarily examine the injury until the removal of the patient, either to the hospital, his home or to some other convenient place.

A person injured in this way, and under these circumstances, will suffer greatly from shock, and will be found cold, with a weakened circulation. Should he have to be transported any great distance the probabilities are that the shock will increase, and that reaction will be greatly retarded, for "every pain is a twinge at life." In such cases the knife is at once demanded, and should be resorted to as soon as the patient can be taken to a convenient place to make the operation. We would call attention to the deceptive character of railroad injuries. In some cases the external surface of the injured part may appear innocent, and yet it is necessary before making a diagnosis to inquire carefully into the circumstances of the injury. I have seen cases where the limb was crushed and yet there was no discoloration of the integument. An ordinary freight car will weigh about twenty thousand pounds, and when loaded the whole weight will be from twenty to thirty tons. Several cases have been witnessed where an arm or a hand had been caught between the drawbars of such heavily loaded cars, and the soft parts crushed to a pulp, but no discoloration of the skin was visible.

November 26, 1887, the writer was ordered to Crestline, Ohio, to see a young man who had his arm caught between the drawbars while attempting to make a coupling and who was informed by the local surgeon that the arm could not be saved, but he refused to have the amputation made until other counsel could be called. More than twenty-four hours had



passed after the accident until the personal examination was made, yet there was no discoloration of the skin, although the soft parts including the blood vessels were literally crushed, so it had to be amputated. In all such cases we must not judge from appearance but from careful examination.

Dr. B. E. Paterick, of Sheldon, Ill., in a paper read at the meeting of the surgeons of the Wabash, St. Louis & Pacific Railway, June 4, 1883, reported the following case: "January 3, I was called by telegraph to see a man injured by the cars at Idaville, Ind. On arriving I found the injury was to the left lower extremity. The skin was lacerated from the middle of the leg, on the front, and in the middle of the thigh. Except the rent in the skin mentioned it was continuous everywhere, but around the leg it was detached from the connective tissues, and the hand could have been passed under the leg between the skin and the muscles. The muscles of the leg were torn and badly crushed. The bones were not injured in any way. The joints were sound. The larger vessels were not involved, so far as I could tell as there had been a surprisingly small amount of blood lost.

I told the man he could not live unless he would submit to amputation. This he refused to do so I did the leg up in a roller bandage, and sent him to his home in Peru, Ind.

I reported the case to our Chief Surgeon, Dr. J. T. Woods telling him I thought the man would die if his leg was not amputated; and shortly after I received a letter from him in regard to the case which made me believe he thought amputation unnecessary in the case I had given him. I had written to Dr. Higgins, the Wabash surgeon at Peru, asking him to report to me how the man got along. On the same mail which brought Dr. Woods' letter I received my answer from Dr. Higgins, saying that the man was dead. It seems to me, with the case before me, that there was but one thing to do, and that was to amputate. But when it was transcribed to paper, which showed no bones injured, no joints, no periosteum, no large blood vessels involved, it did not seem so very bad an injury, and I had not made Dr. Woods comprehend its magnitude.



This was a deceptive case of railroad surgery, not to the surgeon on the spot, but to the one who has to form his opinions from reports. I do not think many surgeons, would advise amputation in the same case, if it came before them on paper instead of in actual practice, and yet the man died within three days."

There is no doubt that the habits of railroad men have much to do with the tediousness of recovery after injury, and should always be considered when examining a wound. Surgeons know that irregular hours for sleep or meals, and intemperate habits have much to do in debilitating the general system, and reduce the vitality so that repairs of extensive wounds cannot be as rapid in an individual who has for months been living without regular meals or sleep, and who has vainly attempted to make up the loss of vitality by resorting to the intoxicating cup. It requires experience and careful study to successfully and correctly diagnose the cases of railway injuries, and of deciding whether amputation is necessary or not. Conservative surgery has done much good, but it has also done much harm. It has its limits. A young man in good health, with regular habits as to sleep and meals, with a good healthy constitution will often promptly recover from the effects of a severe injury, while a much less injury in an anemic or dissipated person may destroy life. There is in many cases a great difficulty in ascertaining the precise amount of the lesion. The mischief may be deep seated, and upon careful examination it may be found to involve most of the important structures.

Compound fractures frequently require amputation. In fact in most cases of railway injury, where the fracture has been caused by direct violence, amputation will be required.

In these cases the the soft parts are so severely injured that any effort to save the limb will be fruitless. It is true there are not so many amputations made for compound fractures at the present time as in years past, and where the injury is not caused by direct violence and the soft parts are not severely injured, many limbs may be saved by the improved methods of treatment, that were formerly sacrificed. But when a limb

is fractured and the soft parts are crushed, as is generally the case in railway accidents, owing to the heavy machinery causing the injury, with bones comminuted, amputation will have to be resorted to.

John Ashhurst, Jr., M.D., in his article in the "International Encyclopedia of Surgery," says: "Great comminution of the bones may of itself be a cause for amputation. In the upper extremity, conservative measures may often be successful, loose or partially detached fragments being removed, and projecting ends of bones sawed off if necessary to effect reduction. But in fractures of the lower extremity, if the fragments which require removal involve the whole thickness of the femur or tibia, the resulting limb, should recovery follow, would in all probability be an encumbrance rather than a benefit. Under such cases amputation should be resorted to." Compound fracture of the knee joint, when caused by railway injury, should always be amputated, and in most cases of compound dislocations of this joint, and of most of the large joints, the knife must be resorted to.

#### PERIOD FOR AMPUTATION.

Much has been written as to the time to make an amputation after an injury has been received. Most of the surgeons adopt the periods, viz.: Primary, intermediary and secondary.

By the primary period is meant the time which elapses between the reception of the injury and the commencement of the fever, or the time when reaction is established. The intermediary applies to the period during which the patient is suffering from the inflammatory fever which is due to the local injury. The secondary period commences with the subsidence of the constitutional disturbance and acute local symptoms, and the commencement of suppuration. The limits of the primary period are placed between five and thirty-six or forty-eight hours. Very able surgical writers have given, we may say almost universally, the preference to the primary period as that in which amputations can be done with the

greatest prospect of success. There are a great many reasons for this opinion. One is, that a patient receiving an injury requiring the amputation of a limb is in this period less sensitive to the pain, and there is not so much shock produced by the operation as later on. Dr. L. E. Russel, in an interesting paper, read at Fort Wayne, Ind., May 15, 1887, at the meeting of the Pennsylvania Company's surgeons, said on this point: "Books teach that the surgeon should wait until the injured victim has partly recovered from the shock before amputating." This, the writer believes to be a grave mistake. Many a golden opportunity has gone glimmering through procrastination.

To be sure while under severe shock the blood may not spurt from the arteries, and the viens may be inclined to leak or drip; yet the veins may be ligated, and the arteries found and secured at the proper time. The patient then has a clean cut surface, and when reaction commences there are no injured nerves to prolong the shock. The stump should have two or three temporary sutures approximating the cut surfaces, the ends being long enough to unite when ready to complete the operation. In severe and prolonged shocks use the A. C. E. mixture of alcohol, chloroform and ether, 1-2-3, until the patient fairly reacts. I know of no better remedy to counteract shock, and put the patient in condition for the amputation. Dr. J. B. Murdoch of Pittsburgh, Pa., in a paper published in the *Journal of the National Association of Railway Surgeons*, October, 1888, says:

"The surgeon called to attend a person who has sustained a serious injury to one of his members, has a great responsibility placed upon him. The most important question to be determined is whether the member has been so hopelessly injured as to be of no further use to its possessor. This, although the first, and generally the most difficult, is not the question which we propose to discuss in this paper. In this paper it is taken for granted that the member has received such an injury as to render its recovery impossible, and my subject is the period of time at which amputation should be performed. Surgical writers divide amputation into two classes, namely, primary

and secondary, the primary being those performed during the first twenty-four or thirty hours, before any inflammatory action in the part injured has taken place. By secondary amputation is meant all operations made after that period. It is with this meaning of the terms primary and secondary that the statistics in our older surgical works are given. Some of our more recent authorities make four subdivisions, viz., the immediate, the primary, the intermediate and the secondary; but they are not exactly agreed upon the limitation which they assign to these periods, nor indeed upon the nomenclature, but the differences are not very important. According to Dr. Frank H. Hamilton, the immediate period is the space of time comprised within the first few hours, many establishing its limit at the expiration of six hours, the period previous to the occurrence of reaction. The primary period is the period between the occurrence of reaction on the one hand, and the accession of inflammation on the other, and it may be said to commence at six hours and terminate at forty-eight hours. The intermediate period ("media consecutive," or secondary for some writers), is so called because it is intermediate between the primary and secondary, and is limited on the one hand by the accession of inflammation, usually but forty-eight hours after the receipt of the injury, and on the other by the occurrence of healthy suppuration. Which latter limitation is exceedingly variable, and may be sought anywhere between seven and twenty-one days, it is the period of inflammation. The secondary (ulterior or consecutive of some writers) is the period of complete suppuration, and its limits are indefinite. The division of amputation into four instead of two subdivisions, is thought to be a useless refinement. But the terms must be understood, and are useful in discussing the subject. Statistics on the subject of amputation, as to the period of time at which they may most safely be performed have been kept, including such large numbers, and by such competent observers, that we can know with tolerable accuracy and risk which any one may run in having any given limb removed.

Of 428 capital amputations upon 423 patients, performed at the Pennsylvania Hospital, Philadelphia, during the 30 years from 1830 to 1860, 321 were cured and 103 died, a mortality of 24% ; 261 were primary, 54 died, a mortality of 20% ; 83 were secondary, 31 died, a mortality of 37.35%.

In the medical and surgical history of the war of the rebellion, an accurate record is given of 827 cases of ex-articulation at the shoulder joint ; 499 of these were primary, with a fatality of 24.1% ; 157 of these were intermediary, with a fatality of 45.8%.

There were 5.273 amputations of the upper arm ; 3.250 of these were primary, with a fatality of 18.4% ; 902 of these were intermediary, with a fatality of 33.4% ; 40 of these were secondary, with a fatality of 27.7%.

Erichsen furnishes us with a table, showing the results of primary and secondary operations in civil practice :

SEAT.	PRIMARY.			SECONDARY.		
	Caser.	Death.	Per Cent.	Cases.	Death.	Per Cent.
Thigh.....	235	153	65.1	156	85	54.4
Leg.....	405	178	42.9	150	72	48
Arm.....	276	76	28.6	75	32	42.1
Fore arm.....	160	16	8.1	27	6	22.2
Total.....	1106	426	38.5	408	195	47.7

At the Western Pennsylvania Hospital, this city (Pittsburgh), from 1872 to 1879, 92 capital operations were performed ; 73 of these were cured, and 19 died ; of these there were of the thigh 19, with 7 deaths, 37% ; of the leg 30, with 4 deaths, 13.22% ; of the arm 10, without a death, 0% ; of the fore arm 9, without a death, 0%.

From these statistics, and thousands of others which might be produced, it is easy to show that the primary amputation



of any limb (with perhaps the exception of the thigh above its middle in the adult) is a safer amputation than secondary amputation of the same limb.

If we would look for advocates for secondary amputations in military practice, we must seek for them mainly among army surgeons of the last or of the early part of the present century, while Petit, LeDaru, Bromfield, Boucher, Luthria, Hennen, Roux, Rush, Armand, McLeod and a host of others, have decided in favor of primary amputations.

I know that it is claimed by some surgeons that secondary amputations are more successful than primary in civil cases, but the observations of Lidel, Stone and others, have rendered this doubtful. It is probable that if attention was directed only to those amputations made in civil practice for traumatic injuries, the results would be found favorable to primary amputations. In my opinion, the distinctions sometimes made between civil and military surgery are often more nice than wise. No good reason has ever been given, nor do I believe any exists in fact, why a limb which has been shattered by the bursting of an engine, or by being passed over by a car, should receive any different treatment from one which has received the same amount of injury from the explosion of a shell, or by being carried away by a cannon ball. One hundred years ago, when the wounded in battle were transported long distances in rude ambulances over rough roads, there were reasons why some limbs should be amputated which might, otherwise, have been saved. But at the present day, in civilized warfare, when the methods of transportation are so good, and there is no fear of cruelties by having the wounded fall into the hands of the enemy, I can see no earthly reason why a soldier should not be treated the same as a civilian, or why a patient in a tent should differ from one in a hospital. If primary amputations are more successful than secondary in military, the same thing should, and I believe does exist, in civil practice where the operation is performed for traumatic injuries. From the statistics which I have given, it is easy, as already said, to estimate the risk that every patient runs in



having a limb removed. It must also be evident that amputations for traumatic injuries are more successful when performed before inflammatory symptoms have commenced than when performed after that period, in civil as well as in military practice. In drawing conclusions from statistics of primary and secondary operations as laid down by surgical writers, there is a fallacy in the reasoning of many surgeons to which I wish to call special attention, the more so because it is not alluded to by our surgical authorities.

At consultations where the question of primary amputation of an injured limb is the subject of discussion, the remark is often made by those who favor delay that inasmuch as the statistics of the operation under consideration show the fatality from the primary is but little less than the secondary amputation, there can be but little risk in delay.

To illustrate my meaning, let us suppose that the case is one of compound fracture of the ankle joint. The remark will perhaps be made by some one who favors making an effort to save the limb, that if unsuccessful a secondary operation can be performed, and that the patient will run but little risk in the delay, because statistics show that secondary amputation has but five per cent more fatality than primary. Now this is false reasoning.

There is much more difference in the risk of life which is run by the patient when the amputation is delayed than the difference between the risk of primary and secondary amputation would indicate.

If the primary amputation is performed statistics will give a fair idea of the actual risk run, but if the operation is delayed and afterward a secondary operation has to be performed, there are no statistics that will indicate the risk run; because before the time has arrived for a secondary operation risks of death have occurred which cannot be calculated. If the period of performance of a primary operation is permitted to pass, it will generally be necessary to wait until suppuration has been established before it will be safe to operate [for during this immediate period all experience teaches that the fatality from

amputation is very great]. During this time, and before the period for the performance of secondary amputation has arrived, the patient may die from exhaustion, from tetanus, from secondary hemorrhage or from septicemia; so that it will be seen that the statistics of secondary amputations only indicate the proportion of recoveries in those who live long enough to submit to it, but give no indications of the risk that is run by the postponement of the operation. If we were in the possession of tables accurately kept, which would indicate the risk from the other causes of death, then by adding those risks to the risks caused by secondary amputation, we could judge of the danger of delay. In order to illustrate this point I will cite the following cases, which have come under my own observation. In September, 1870, a healthy young mason fell from a scaffold at the Oswego starch factory. When examined, two hours after the fall, it was found he had sustained a compound fracture at the lower third of the femur, the upper fragment protruding through the skin. There had been a good deal of arterial hemorrhage, which had ceased at the time of examination. The limb was cold and senseless and no pulsation could be detected in either the anterior or the posterior tibial arteries. The diagnosis was compound fracture of the femur with rupture of the femoral artery and injury of the anterior crural nerve. As there were no symptoms of shock I advised an immediate amputation of the thigh. This was not acceded to, and I was asked to delay treatment until a consultation could be had with Dr. Shipton, an old and experienced surgeon from Syracuse, N. Y., a distance of 140 miles from Oswego. Dr. Shipton agreed with me in the diagnosis, but did not approve of the treatment which I advised, and I retired from the case in opposition to Dr. Shipton and the patient. Dr. Shipton then took charge of the case.

The external wound was closed by adhesive plasters and the limb extended by the use of the long splint. In 48 hours from the receipt of the injury the great toe assumed a dusky shade, which gradually became black and gangrene extended up the limb. The patient gradually sank, and before any line

of demarkation had been formed expired from exhaustion on the 15th day after the injury. Again, J. H., Englishman, laborer, healthy; admitted to the Western Pennsylvania Hospital on the evening of February 19, 1874. A few hours previous to his admission, while engaged with a fellow workman in raising a heavy piece of metal by means of a crane worked with two handles, his companion let go his hold, and the whole weight suddenly fell on him. Being unprepared for the sudden weight which came upon him the iron handle of the windlass slipped from his grasp, and while revolving with great velocity in the reverse direction from which he had been turning it, struck him a powerful blow upon the thigh, just above the knee joint.

On examination, a lacerated wound about two inches long was discovered above the patella. The rectus femoris and anterior portion of the vastus externus muscles were torn from their attachments, and the finger could be easily passed into the joint. By this means it was found that a fragment had been broken from the external condyle of the femur, the patella displaced inwardly, and the inner end of the broken fragment thrown upon it.

Constitutional disturbance was not great. A consultation was held on this case about 24 hours after the injury, and it was decided to delay amputation. The parts were restored as far as possible to their proper position, a plaster dressing was applied from the foot to the groin, and after cutting a fenestra through the plaster over the knee a bladder filled with ice water was applied to the joint. The limb and joint were thus kept immovable; the constitutional treatment was in accordance with the general principles of surgery. It is unnecessary to give further details of symptoms and treatment, but notwithstanding the greatest care and attention, the patient gradually sank and died on the fifth day after the accident.

There would be no difficulty in citing many cases similar to these. During the past six years I can recall six cases of compound fracture into the ankle joint which have come under my supervision, in which primary amputation was delayed and the

patients died of septicemia without giving any opportunity for the performance of secondary amputation.

For these patients the golden moment was lost when the period for making the primary amputation was permitted to pass. It will perhaps be said that these patients might have died had the primary amputation been performed. This is no doubt true; but if primary amputation had been performed we could have judged in advance the risks run. In primary amputation of the thigh, as we have seen by the statistics, the mortality at the Western Pennsylvania Hospital is 37% of the cases; at the other hospitals it is higher.

At the Western Pennsylvania Hospital the mortality from primary amputation of the leg is 13.22% of the cases. Now, if it is admitted that in the cases which have been cited the limbs were hopelessly injured, it will be seen that if the limbs were amputated primarily the surgeon would know just what risk his patient would run; but when he decided to delay the operation with a view of performing a secondary amputation, he could not tell the risks which were taken; for in addition to the hazard from secondary amputation, all other risks of death which might occur before the period of complete suppuration had arrived must also be taken.

From what has been said it must be apparent that the surgeon who has delayed performing a primary amputation in a case which afterwards requires amputation has subjected his patient to very many risks of losing his life which might have been avoided. And not only has life been hazarded by the surgeon's want of foresight, but much unnecessary pain, suffering, and loss of valuable time, which to the poor man (and it is to such that those accidents usually occur), is not a small consideration. Again, it is not only for the preservation of life that amputations are performed. Amputations are also performed to rid the body of members which, if left attached must be unsightly, useless and cumbersome.

For this reason the probable future usefulness of an injured member is an element which should be considered when contemplating amputation. Another argument in favor of ampu-

tation is the fact known to every surgeon, that immediately after an accident a patient will more readily give his consent for the removal of a hopelessly injured member. Once let a timid or nervous patient recover and he will carry with him for the remainder of his days limbs which are deformed and which he drags after him as a burden and which he would willingly have parted with at the time of the accident and which he would now be glad to get rid of, but has not courage enough to undergo the operation.

Cases like the following are not uncommon: E. E., married, brakeman, æt. 26. On January 10, 1880, his foot was caught in a frog and an engine ran against it, contusing the soft parts of the foot and dislocating the astragulo-scaphoid articulation. It was treated expectantly; the parts were restored to their position, and the wound dressed with carbolized oil; the bones became carious and the wounds did not heal.

February 18, an operation for the removal of a diseased bone was performed, all the diseased portion being gouged out with a chisel. The wound did not heal. April 9, the patient was placed in a continuous bath, and kept in this, at a temperature of 100°F. until May 26.

It is not necessary for my purpose to dwell further on the details of treatment. I saw this man last week, March 10, fourteen months after the receipt of the injury. During this time both he and his little family have suffered untold misery. He is on a pair of crutches trying to do duty as a flagman at a railroad crossing. His injured foot is twice the size of its fellow; the wound has not healed; the bones are in a state of caries.

This man would be better off had he submitted to primary amputation of the part. He has already run fifty times more risk from dying than he would have run had he had the amputation primarily performed; and in the end he will probably be obliged to submit to secondary amputation. I could quote many cases similar to this if I felt that I could take the same liberty with the cases of other practitioners as I do with my own.



What has been said has been in favor of primary amputations, viz., amputation during the first twenty-four or thirty hours after the injury. Nearly all well-informed surgeons will, I think, agree with me in what I have said. But I go one step further, and declare as the result of experience and observation that, speaking generally, the sooner a member which cannot be restored so as to be of use to its possessor is removed the better. I am in favor of *immediate amputation*, i. e., amputation performed within six hours after the injury.

Shock has been the great bugbear which has prevented surgeons from amputating early enough to save their patients. I believe that this condition does not always exist, even after very grave injuries, and it is the opinion of many surgeons of vast experience that shock is often delayed. Such is the opinion of Mr. McLeod. Lidell also believes that shock is generally delayed. Ambrose Pare urged that amputation should be made while the wounded are in sight of the battle—field, and Richard Wiseman, sergeant-surgeon to Charles II., said: "If you decide to operate, do so at once, do it at once while the soldier is in heat and metal."

Larry says: "I have lost a great many soldiers, because, although operated upon within the first twenty-four hours, yet the operation had been made too late." Dr. Stephen Smith, in an analysis of 430 recovered amputations, found that 36% of these were made within six hours of the injury, and has estimated that the rate of recovery was 6% better in these cases than in those in which the amputation was made in the period of reaction, or what is termed the primary period.

The records for the Western Pennsylvania Hospital, where immediate amputation of injury is the rule, show a lower rate of mortality for amputations than can be found anywhere else, so far as I know, as has already been shown by the statistics as given in Erichsen's surgery. Primary amputations have a mortality as follows:

Thigh,	-	-	-	-	-	-	65.7%.
Leg,	-	-	-	-	-	-	43.9%.
Arm,	-	-	-	-	-	-	28 %.
Fore arm,	-	-	-	-	-	-	8.4 %.



At the Western Pennsylvania Hospital, where immediate amputation is a rule the mortality is as follows :

Thigh,	-	-	-	-	-	37	%.
Leg,	-	-	-	-	-	13.22	%.
Arm,	-	-	-	-	-	00	%.
Fore arm,	-	-	-	-	-	00	%.

The number of cases in this hospital is not large enough to make the comparison fair, but this is given for what it is worth.

Let me refer to three cases of amputation of the thigh in the upper third, done for injury in full grown men, which recovered. One was performed half an hour after the accident; another two hours after the accident; the third was a double amputation of the thigh and leg, and was performed one hour after the accident. These cases are reported in full by me in the *Hospital Gazette*, New York, Vol. vi, p. 550. Such cases as these are usually regarded as hopeless. Mr. Erichsen, in the last edition of his surgery, Vol. i, p. 76, says of such cases: "I shall never again, except in children and young people, amputate in that situation for such injuries, hopeless alike whether left or subjected to the knife; but surely better for the patient to be left to die in peace than to be again tortured by amputation, which all experience has shown to be useless."

I regard the unexampled success of the Western Pennsylvania Hospital in a great measure due to the fact that there it is the custom to do immediate operation. What has been said with reference to the removal of hopelessly injured parts is true whether the amputation required is one at the hip-joint or is one of the little fingers. If the part is destroyed the sooner it is separated from the body the better. To amputate at once, if the patient is not in a dying condition, is to save life and prevent pain and suffering.

Now, if I am right in what I have said, and I believe I will be supported in my statements by those surgeons who have had most experience, there must be a great deal of bad surgery practiced in the community. This is illustrated frequently in the smallest, as well as the largest members of the body.

There are, perhaps, no accidents so common here as those which occur to the brakemen on our railroad cars, caused by having their hands and fingers crushed while making couplings, and how common it is to see those men carrying about with them fingers hopelessly injured, they suffering from pain and their families suffering from want for months, and in the end either recovering from their injuries with deformed fingers, which are incumbrances to them, or submitting to their amputation. And how frequently do we see, on our public streets, strong, muscular men, dragging after them useless members which might well be replaced with artificial limbs. And still again, hid away in alms houses, garrets and back rooms, are many poor creatures who have suffered for years with useless limbs, the results of accidents. These people, useless to their kind, ostracised from their race, are never called upon by anyone unless, perchance, it be the so-called conservative surgeon, who calls to exhibit to some friend the limb which he has saved, and which his rival in practice wished to remove. Such surgeons should read what Allcock says: "The object of saving a limb is that it may be useful. If this is not the result, the member, by merely hanging to the body of the patient, is lost, in my estimation, as truly as if amputated, but with the additional circumstances of being converted into a source of misery to the sufferer, an impediment to the free motion of the rest of his body, and often a cause of irremediable bad health. Such cases I hold to be among the worst specimens of bad and injudicious surgery."

I have dwelt thus long upon the advantages of primary and immediate amputation over those performed at a later period, in order to impress upon you the dangers of delay.

Not that I would, by any means, advise the amputation of a member of which there is good prospect of saving, but in order that you may feel the full sense of the responsibility which you are undertaking when you advise delay in a case of doubt.

It must also be apparent how necessary it is for the practicing surgeon to study carefully into the nature of injuries, and be able to tell at the time of the injury in which recovery may

be expected. This is a subject which, in my opinion, does not receive sufficient attention in our medical schools or from our systematical surgical writers. It is only after the most diligent study of the experience of post surgeons, together with much personal observation, that the opinion of any surgeon in such a case is of any value.

The surgeon who is not governed by the experience of the masters of surgery, but relies upon the comparatively little experience of his own, and it is only a little experience that any one surgeon can have, when compared with the united experience of the profession, will probably, after he has sacrificed many lives, come to agree with his predecessors.

Says MacLeod, on this subject, "every succeeding generation of surgeons go through, to a great extent, the same ordeal in gaining their experience. They suppose that their advanced attainments encourage an attempt which their predecessors feared, and thus a vast number of lives are being sacrificed to the establishment of an individual experience."

Far be it from me to intimate that there will be no future progress in this department of surgery. I am fully aware of the progress which has been made in the past, and I believe that many limbs were formerly sacrificed which are now saved, and that many are now sacrificed which a future generation of surgeons will save. The discovery of new methods and new principles may render the statistics of the past valueless as a guide for the future. The genius of Napoleon introduced a new system of tactics into the art of war, and Ambrose Pare, by the introduction of the ligature as the means of controlling arterial hemorrhage, revolutionized the treatment of wounds. And there may be to-day, perhaps in our midst, the genius who, by the introduction of some new principle or method, will wipe out all value as a guide for future practice the collected experience of the past one hundred years, and teach us how to save limbs which are now regarded as hopeless. Such a one would be who could teach us how to treat compound fractures, and fractures into joints, with the same felicity that we now do simple fractures. Such a one, while living, would receive all

the honor and respect which the medical profession could lay at his feet, and, when he came to die, his, like those of Pare and Harvey and Lister, would be one of the few immortal names that were not born to die.

But it should be remembered that discoveries that revolutionize practice, like the discovery of the application of the ligature by Ambrose Pare, or the use of antiseptics in the treatment of wounds by Lister, do not occur more frequently than once in a century, and that, while we honor the names of Pare and Lister, we have only pity and contempt for the man who, without having discovered any new method or principle, but, depending upon those who are known to all, ignores the experiences of the past and disregards the teachings of the masters in surgery. Such a one, by boasting of cures which neither he nor any one else has or can perform, may for a time succeed in deceiving the public, but he only excites the derision of his professional brethren.

It is not the intention of this paper to discuss the conditions of injury which indicate that a part has been hopelessly injured, so as to require amputation. On some future occasion we will discuss this subject. I will only say now that compound fractures into the knee-joint, generally, and compound fractures into the ankle-joint, frequently, when they occur in the adult subject, demand amputation. But, as we have so often heard the boast made by the so-called conservative surgeons that they have saved limbs over which loaded cars have passed, let me say a few words on the subject. I subjoin a table giving the weights of cars:

							LBS.
An empty gondola, or platform car,	-						17,000 to 20,000
“ “ box car,	-	-	-	-	-		17,000 “ 24,000
A Coach,	-	-	-	-	-	-	30,000 “ 40,000
A Locomotive,	-	-	-	-	-	-	80,000
A single pair of car wheels alone,	-	-					1,000

When a car wheel passes over an object which lifts it up, as is the case when it runs over an arm or a leg, it is estimated by

those who are best able to judge, that one-third of the entire weight of the car rests upon that object. How absurd it is to think that any human limb will sustain such a weight and retain its vitality. Any surgeon who has seen a limb which has been traversed by a car wheel, knows that it cannot be saved.

These are the plainest cases for amputation with which we have to deal. Sometimes, as in one of these cases already related, the limb is entirely separated from the body, but generally it still holds by shreds of skin and tendon. Any one who has ever seen such a limb at once knows that it is lost. To cut it off at once is humanity as well as good surgery. And yet it is not uncommon to hear a young surgeon talk of having cured a limb over which a car wheel had passed. It is not uncommon for a patient with a limb injured in a railroad accident to declare that the wheel passed over the part. But the victims of accident are not often good witnesses of the occurrence; they are dazed or stunned, and often have little idea of what has occurred. But if they were the most reliable witnesses in the world their statements would not be believed when at variance with the laws of force and resistance, which are a part of the laws of nature. And to believe that these laws are set aside or suspended is to believe that a miracle has been performed.

I am aware that it will be urged by many, as an argument against the removal of an injured limb, that many limbs which have been pronounced hopelessly injured, by experienced surgeons, have, when the patients would not give their consent to the operation, recovered. But there are not so many cases of this kind as some would have us believe.

In every section of the country we have old soldiers, who, while exhibiting their honorable scars to gaping crowds, tell how, with revolver in hand, they defended the limb which the doctors wished to remove. Every surgeon who has been in the army knows that the men who tell these stories are blatant liars. Neither in the army nor out of it do surgeons run after patients with catlin in hand to cut off arms and legs without the consent of their owners. But it must be admitted as a fact

that a limb is occasionally saved which all experience would indicate must be lost; but exceptions do not make rules.

Guthrie, after emphatically protesting against our being guided by these exceptional cases, says: "If one case of recovery should take place in fifty, is it any sort of equivalent for the sacrifice of the other forty-nine? Or is the preservation of a limb of this kind an equivalent for the loss of one man?"

Bryant says: "To sacrifice a limb unnecessarily is an error which the surgical mind would never willingly commit, although to sacrifice a life in the feeble effort to save a limb is an event of far greater magnitude, but it is one that timid surgeons are too prone to fall into when inoculated with the narrow views of a spurious conservatism. For its avoidance, a high order of knowledge is demanded; a careful balancing of probabilities, and much decision. To leave a limb alone with a view of saving it is a passive act of the professional mind that requires no effort; to make up the mind to act demands much effort, backed up with knowledge and a full sense of responsibility.

"That you may thoroughly appreciate this responsibility, and while remembering that to save a limb is greatly more to your credit than to sacrifice it, you may also remember that to act for the best interests of your patients you must be governed by the experience of the past, and be ready to act promptly and with decision. To teach this lesson has been the aim of this article."

Dr. W. B. Outen, of St. Louis, Mo., one of the leading railway surgeons of the country, in a paper read at the meeting of the National Association of Railway Surgeons, at Chicago, June 28, 1887, says:

"It is not our intention to discuss the general field of amputations, but mainly those made after railway injuries. If there be any class of injuries *sui-generis* and peculiar to railways, it is those injuries arising from the passing of ponderous and rapidly revolving wheels over a part of the human economy, causing effects peculiar to the manner and method inflicted, and possessing characteristics which are plain and evident."

"Owing to a constant augmentation in the mileage of rail-



ways and the constant occurrence of cases of this character, the subject is one of importance and deserves close scrutiny and conscientious consideration.. While the same general rules laid down for the conduction of amputations other than those occurring upon railways may hold good in this class, still we maintain that the strict adherence to such rules as indicated by text books, frequently leads to results otherwise than good.

"The great bulk of operations made after railway injuries must be classed as unavoidable loss of vascular connection, a contusion and laceration of all tissues, exposed so that the essential part to be determined is the time when the part had better be amputated. Neither age, habit, functional derangement nor organic diseases must be considered otherwise than in a prognostic sense. Our chief object in the amputation is, of course, to save the individual's life and leave him in the best possible condition to meet the exigencies of his existence. We do not propose to go over the entire field of discussion as to the proper period of time when amputations should be performed. We consider that since the introduction of antiseptic wound treatment, newer and better factors in treatment have been introduced, and the by-play of septic infection greatly decreased and not the element of importance and danger, as in the past. In no class of cases in all surgery is there a more varied manifestation of shock than there is in these railway injuries.

"Shock in its milder form, shock where the brain and cord are obtunded, the organs of special sense dulled in their functions, the clammy sweat, the dry mouth, husky throat, collapse of muscular energy and a heart struggling to make up in frequency of beat what it has lost in force—mental shock combined with physical shock. Indeed, so deeply have we been impressed with the effect occasioned by the fear, by the horror produced in viewing the cause at the time of the accident, that it has convinced us that a person injured at night and unable to see all the attending circumstances has a much better chance of recovery than where all the senses have full play; and in reviewing cases I find that the most severe injuries followed by

recovery have occurred at night so frequently as to force the conclusion that, in railway injuries particularly, the time of day, as a rule, is an important factor in the result. The constant manifestations of shock in its severest forms, utter inutility of our best endeavors in treatment, make them a class of cases of increasing interest and grave responsibility.

"Out of 103 railway injuries, caused by the passage of locomotives and cars over the parts, attended by the writer, involving the superior and inferior extremities, excluding injuries to hands and feet, more than one-third died from shock, without operative interference. This, we conceive, without other elements of mortality, makes it indeed a large average of mortality. Now, if the mortality is so excessive from shock, we conceive that in many cases we make it purposely so by injudiciously insisting upon a too early performance of the amputation. While we may be justified by evidences of reaction, and additionally justified, when, upon administration of the anesthetic, we have an increased volume of pulse, still, we do not believe that reaction from shock does take place in twelve, twenty-four or forty-eight hours, and the additional shock of operation too frequently terminates in death. While we do not insist, in every injury, of refraining from primary amputations, knowing too well that in these extensive and lacerated wounds foreign and extraneous substances are literally ground in the tissues, and that their removal would involve almost as much shock as the operation, yet we do believe that by careful and painstaking attention a goodly number of these injuries can be made aseptic, and secondary amputation made when the nervous system is in the condition to bear the operation and the tissues in the best condition to make the proper flap. Again, how frequently do we find it almost impossible to tell uninjured tegument from the injured, the appearances being essentially the same. A rapidly revolving ponderous wheel has passed over a limb, grinding and twisting in its passage all tissue; not infrequently we find a patch of skin, which, in consequence of this twisting process, has not only robbed the surface of its vascular supply, but even robbed it of its nerve

supply, and should this be included in the flap, it is but dead tissue. As regards this one point, we conceive that it will pay the surgeon in his examination to apply the esthesiometer, or at least the point of his knife, to determine the anesthetic condition of the skin. From our own experience we are convinced that, in almost every instance, if there was loss of sensation the integrity of the flap was involved. Almost every tissue in these injuries present uncertain aspects, and it is difficult to determine the extent of injury, but when a secondary amputation is made these elements cease to exist.

"Admitting that in military surgery the mortality in secondary amputations was enormously high—that Faust saved only 30 in 300 amputations, and that the general average ranged between 86% and 90%; still, these were done in the days when the septic influences had perfect sway, and septic conditions uncorrected. No such mortality can occur under the existing forms of antiseptic treatment, and, indeed, we have constantly had better results under secondary amputations than when primarily performed. In these injuries the surgeon cannot be too careful in eliciting the most complete and perfect history of the manner in which the accident occurred. Even such minor details as position, the amount of muscular exertion indulged in, rapidity of movement of the inflicting agency, whether an engine or car; in fact, the minutest detail is of value, and because a ponderous weight has been applied to a part, a surgeon is not justified in jumping at any seeming foregone conclusion, but should study thoroughly the condition as presented. The position of the individual at the time of receiving the injury plays a very important part in its treatment; thus, for instance, suppose the individual be facing the agent inflicting the injury, his foot being caught, he at the same time is thrown violently backward, no one can doubt that there would, of necessity, be greater injury to the proximal-joint injury, and particularly so where frantic muscular effort was indulged in to get free. Indeed, from our own experience, we always doubted the propriety, prior to the introduction of antiseptic surgery, when such history could be established, of attempting any operation

at or near the joint. This is particularly so in regard to the ankle-joint, so frequent, by bad results obtained, that we maintain that Pirrgoff Hey, or Chopart amputations are always dangerous experiments, for in such instances you will invariably find a most severe contusion of the joint, a rupture of all the ligaments, and not infrequently injury to its vascular supply, and very often the skin of the parts, separated from the cellular tissues beneath by the twisting process of a revolving wheel, far beyond the point of its apparent injury. With so many adverse agencies to contend with, a primary amputation at or near this joint is very frequently a dangerous procedure, and indeed, while it may not be in the effort of conservatism, we consider it much better to amputate above these points. Disarticulation in railway injuries, considering all attendant circumstances, has been, in our experience, doubtful procedures. \* \* \*

"Examine everything in connection with these injuries. The same painstaking, careful study of detail which leads the specialist to fine results, holds pre-eminently good in railway injuries. The inspection of the apparel worn by the individual at the time of the injury has saved the writer from the contumely of inferior prognosis more than once.

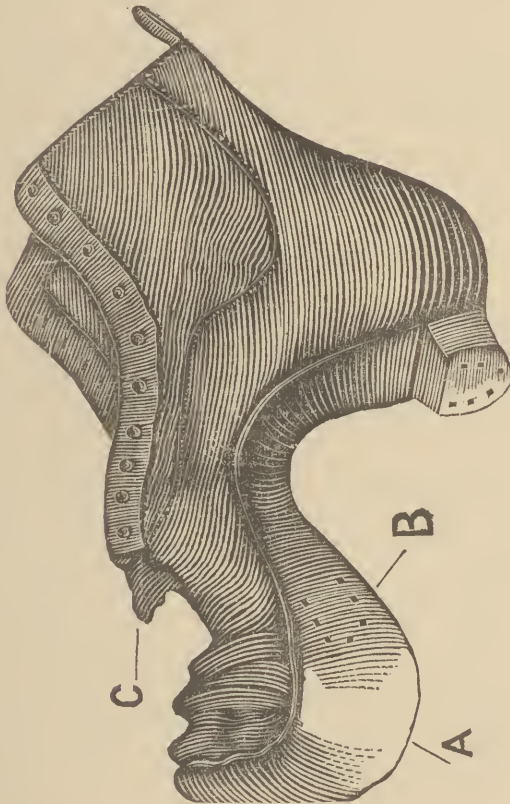
"Thus, for instance, the accompanying cut represents the condition of a shoe worn by an individual whose foot was caught under the pilot of an engine. Upon inspection of the injured foot, a lacerated wound was found extending from the tibio-astragaloid articulation over the dorsum of the foot to the metatarso-phalangeal articulation of the great toe. Owing to rapid effusion around ankle-joint and neighboring tissue, its exact condition was masked and could not be determined; but an inspection of the shoe worn at the time of the accident conveyed a more graphic description of the absolute amount of force used than could be conveyed in words.

A.—Represents sole of shoe bent double upon itself.

B.—Nail marks showing that heel had been pressed so forcibly upon sole as to leave a permanent impression.

C.—Rent in shoe where foot was partly forced out of shoe.

"Viewing foot and its not apparent extent of injury would naturally make one, at first sight, give a favorable prognosis, but upon inspection of shoe with almost every line of contour detailing the immense amount of force applied on so limited a



space, indicated an injury of the gravest sort, and forced a guarded prognosis. The result verified the unvoiced story of the shoe, for amputation was the result. Indeed, the surgeon dealing in this class of cases should post himself as regards the characteristics of the agencies which inflict them. A knowledge thus obtained is an element determining in many cases the treatment. If in military surgery it is important to study the



shape of missiles, etc., so in railway surgery the agents inflicting injuries convey important points, both in prognosis and treatment. We are thoroughly convinced that the successful surgeon in railway injuries is the one who pays attention to every detail, and ignores not the minutest element of their history."

We have quoted the above to show that there is still a difference of opinion among leading surgeons as to the period of making amputations. The experience of the author is that in the majority of cases better results will follow the primary amputation.

#### SPECIAL AMPUTATIONS.

Having already referred to the different methods of amputating limbs, viz.: circular and flap operations, and also briefly called attention to some of the advantages and disadvantages of these different methods, we will now call attention to some of the operative procedures in special amputation. It is very easy to give precise rules to govern us in making an amputation through sound and healthy structures, but in cases where an amputation is required in consequence of severe injury the tissues will be found irregularly destroyed, and the surgeon will not have the opportunity of making the selection of either the flap or circular method, but will be compelled to amputate so as to save as much as possible of the limb and to have enough healthy tissue to cover the stump.

Thus it will be readily understood why railway surgery differs from general surgery.

In amputating a finger, the operator should always endeavor, when it is possible to do so, to bring the flap from the palmar surface so that the cicatrix will be on the dorsal aspect. This will apply in all cases of amputations, either of the fingers, hands, toes or feet, for the reason that an unhealthy cicatrix on the palmar surface is a great annoyance to the patient, and frequently renders the hand or foot almost useless all through life.



It has been the experience of the writer that in many cases where an amputation has been made so that the cicatrix was on the palmar side the patient would suffer very greatly whenever attempting to use the hand, or the foot in walking. It is therefore preferable, when it can be done, to bring the flap from the palmar surface, and thus avoid the danger of a tender cicatrix. In injuries of the fingers, caused by the deadwoods or draw-bars in making couplings, the surgeon will frequently have to select the flap from the dorsal aspect, or, it may be, from the lateral portion of the finger. In such cases he should be very careful to have sufficient healthy tissue to cover the stump.

The knife best adapted to amputations of the phalanges is a narrow, short-bladed, sharp-pointed bistoury, with a good stout handle.



*Oval Operation.*—The oval operation, or that which is known as that of Scoutetten, is regarded as a modification of the circular operation, the skin being slit up one side and the covers trimmed off. There are two sub-varieties of this method.

*Method of Scoutetten.*—"In this, an incision is begun on the outer side of the limb and carried obliquely downward for a distance about equal to its diameter; then continued transversely across the inner side of the limb and obliquely upwards again to meet the first incision at an acute angle."

*The Method of Malgaine.*—"This, which is called by French writers the operation *en raquette*, from the racket-shaped form of the wound, is preferable as affording a better covering for the bone at the upper part of the incision."

The phalanges are often injured so that the surgeon is compelled to make a circular or some modified flap. But whenever the parts will admit, the palmar flap should be made so that the cicatrix will be on the dorsal surface.

When the injury is of such a nature as to require the sacrifice of the entire finger, the question arises whether it is best to disarticulate at the metacarpo-phalangeal articulation or to remove a portion of the metacarpal bone. Some operators advocate the removal of the head of the metacarpal bone, so that the contour of the hand may be preserved and the chasm between the fingers reduced, thus allowing them to be brought closer together. But as the head of this bone will atrophy, and when men who have to labor require the full strength of the hand, it is thought best to disarticulate and allow the metacarpal bone to remain, as undoubtedly the hand will be stronger when all the bones are allowed to remain. This is a point mostly of consideration in the operations to be made in cases of railway employes who are compelled to use their hands in the use of the brakes, their various duties on trains and in the shops. Where men are engaged in other employment where it is not so important to preserve the strength of the hand, in order to avoid deformity it will be well to remove the metacarpal bone.

In a majority of cases it will be well to preserve all the tissues that can be saved. The many injuries to which the fingers and hand are exposed, especially in railway service, render it quite impossible to describe in detail the method of amputation required in individual cases. There are, however, some general rules which should govern the surgeon when called to treat these cases. The first is, never amputate when there is the least probability of saving the injured member; the second, do not sacrifice more than is absolutely necessary.

#### AMPUTATION OF THE HAND AT THE WRIST.

This operation certainly possesses some advantage over an amputation through the bones of the forearm. Prof. S. D. Gross says: "Disarticulation at the wrist should always be preferred to amputation of the forearm whenever it is practicable, inasmuch as the mutilated extremity offers a much longer lever, which may afterward be used with great advantage for various

purposes. At the same time it is more easily adapted to an artificial hand. I have repeatedly seen persons who, after this operation, enjoyed an amount of action in the limb that was truly astonishing, and who expressed great satisfaction at having so good a weapon of defence in accidental pugilistic encounters, the long stump enabling them to deal a most powerful blow" (System of Surgery, Vol. ii, page 1025).

Mr. Erichson says: "The operation may be performed in two ways, the chief flap being cut from either the palmar or dorsal surface." But in this, as in operations on the hand, it is preferable, if possible, to secure the flap from the palmar surface. Some good operators prefer the circular operation. No doubt good results will follow either method, and in many cases the injury will be of such a nature that the operator will not be able to adopt either method exclusively, but will have to make a modified flap or circular operation. The best surgeon is he who can best use the healthy or uninjured tissues to cover the ends of the bones and make a good stump.

In making this operation the integuments should be well retracted and an incision made from one styloid process across the back of the joint, with the convexity forwards.

After the articulation has been opened and the ligaments divided, the knife should be carried forward, making a well-rounded flap from the palmar aspect of the wrist. The flaps should be carefully cleaned, the bleeding vessels secured, and, after all oozing has ceased, be brought together with suture and the stump carefully dressed.

#### AMPUTATION OF THE FOREARM.

Whenever it is possible we prefer the double flap operation, but in this as in many other cases of injury it will be impossible to make either a complete flap or circular operation. In accidental surgery it is quite important that all contused tissue be removed, consequently we may have on one side of the arm considerable of healthy tissue, while on the anterior and posterior parts there are some contusions, requiring a modification

of the flap and circular methods both, in order to save as much as possible of the forearm. The wood cuts with thin dotted lines are very instructive to the surgeon in ordinary practice, but in the practice of railway surgery they are of but little benefit.

When the double-flap operation can be made, the surgeon will grasp the arm with his left hand and thrust the point of the knife into the side of the arm which is nearest to him, then pressing it close to the bones bring the knife out at a point opposite to that at which it entered. He now cuts downward, hugging the bones; when he has cut at least the length of more than half the diameter of the limb he turns the knife and cuts obliquely towards the surface, thus forming a flap, which is at once turned back and entrusted to an assistant. The surgeon again enters the knife at the same point as before, carries it over the other side of the bone and brings it out at the same point on the opposite side of the limb, making a flap corresponding as nearly as possible in size and shape as the former. The muscles in the inter-osseous space are next divided, the flaps retracted and the bone sawed off. In sawing the bones of the forearm both bones should be sawed at the same time, so that they will be precisely the same length. Always set the heel of the saw firmly on the bones to be sawed and draw it towards you full length, thus forming a groove for the blade; then, holding the upper portion of the arm firmly with the left hand, with a firm and steady movement saw through the bones. Have the assistant hold the part to be amputated so as not to make pressure on the saw. The next step in the operation is to ligate the vessels, which are the ulnar, radial and inter-osseous, with occasionally some small vessels from the muscles. Then cleanse the flaps carefully, and, after all bleeding has stopped, bring the flaps together with some unirritating suture. The silkworm gut is excellent material for holding the flaps. Silk thread or horse hair will be found valuable.

## AMPUTATION AT THE ELBOW JOINT.

When amputations at this point are to be made, we must either disarticulate or go above the joint. It is claimed by good authority that the healing process is as rapid after disarticulation, or even more so, than when the amputation is made in the continuity of the bone. This operation was first made by the illustrious Ambrose Pare. It has since been successfully made by many surgeons, and with the most encouraging results. The amputation at the elbow may be made either by the elliptical, the circular or one or the other of the flap methods. The first amputation at the elbow witnessed by the author was made in 1875, by Prof. P. S. Conner, of Cincinnati, Ohio, the subject being a lad whose right arm had been caught by a rapidly moving belt and the forearm torn off at the elbow, leaving, however, considerable tissue on the lateral side of the forearm, which was used as a covering for the stump. The condition of this case will frequently be found in cases of accident, where the surgeon will be compelled to secure a flap either posteriorly or laterally. No positive rule can be given, but when it is possible to do so, the antero-posterior flap method should be employed preferably to any other. The stump after an amputation at the elbow is generally a good one, and this amputation should always be preferred to one higher up.

## AMPUTATION OF THE ARM.

The bone in the arm is so near the centre that there is but little difficulty in making a good stump by using either of the methods, but the antero-posterior flap method is generally preferred by the writer, and has always secured the best results. But many good operators give preference to the circular method. If there is sufficient tissue to make a good covering for the bone, the surgeon can hardly fail to obtain a good and satisfactory result by whatever method he may employ.

## AMPUTATION AT THE SHOULDER.

The few cases where the author has been called upon to make this amputation have been where both the bone and soft parts were seriously injured by heavy car wheels passing over them, or where the arm had been caught in making a coupling,



and in consequence the soft parts were much contused and no choice left as to the method of operating except such as would best secure sufficient covering for the stump. When it can be done, the flap operation is preferred, but the oval method



is much employed. The flap method is easily made, and the hemorrhage can readily be controlled by the assistant following the knife and grasping the vessels and compressing them before the surgeon divides them. The



compression of the subclavian artery where it passes over the first rib, with a key, is always to be done, and then to use the other precautions named will insure almost a bloodless operation.

Prof S. D. Gross says: "Amputating at the shoulder-joint is one of the most easy operations in surgery. Richerand long ago remarked that it might be performed with the same celerity with which an adroit carver separates the wing of a partridge, and nothing is more true, although I have occasionally seen a case in which the surgeon consumed time enough not only to cut up the entire bird but also to devour it."

The results of this operation, while it appears to be a most formidable one, have been fairly successful.

## AMPUTATIONS ABOVE THE SHOULDER.

This operation consists in removing the entire arm with a part of the scapula, or all of it, and part of the clavicle. The best method is to cut the bones either with good strong pliers or with a chain saw. The results are more than 70% of recoveries. In many cases where the injury has been caused by railway accident the internal viscera has been injured so that inflammation will follow, even if reaction is established. Injuries of this character must be regarded as of a very serious nature.

## AMPUTATION OF THE TOES.

The toes are not so frequently the seat of injury in railway accidents as the fingers to such extent as to require amputation. In a report of 100 cases of railway accident, by W. J. Chenoweth, of Decatur, Ill., read at a meeting of the Wabash Company's surgeons, held at Springfield, Ill., April 30, 1884, and published in the *Fort Wayne Journal of the Medical Sciences*, in the July number of that year, he gives the following statement of the injuries as distributed over the body:

To the Head,	-	-	-	-	-	-	9.
" Back,	-	-	-	-	-	-	5.
" Hands,	-	-	-	-	-	-	35.
" Shoulders,	-	-	-	-	-	-	7.
" Arms,	-	-	-	-	-	-	7.
" Thigh,	-	-	-	-	-	-	6.
" Leg,	-	-	-	-	-	-	4.
" Wrist,	-	-	-	-	-	-	3.
" Ankle,	-	-	-	-	-	-	6.
" Foot,	-	-	-	-	-	-	4.
" Chest,	-	-	-	-	-	-	2.
" Kneec,	-	-	-	-	-	-	2.
" Scrotum,	-	-	-	-	-	-	1.
" Various parts at the same time.	-	-	-	-	-	-	9.

From this report it will be observed that more than one-

third of the 100 cases were injuries to the hand, while but 4% were of the foot.

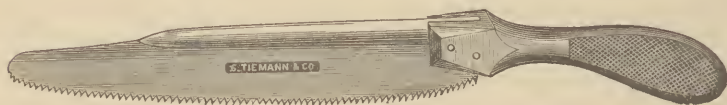
Amputation of the toes should not be made in their continuity or through their phalangeal articulations, as the stump thus made would always be a source of annoyance and pain from the pressure produced by the shoe or boot. The amputation should always be made at the metatarso-phalangeal joints. The operations made at the joints will resemble those of the hand at the corresponding articulations. When one toe is to be removed it is best done by the oval method, for by this method the sole of the foot is not incised, consequently there will be no friction on the cicatrix in wearing a shoe. When all the toes are to be removed it will be better to make the flap amputation and bring the flap from the palmar surface, for the same reason as stated in amputation of the hand. In this operation, as in that of the hand for railway injuries, the surgeon will always have difficulty in making a good flap out of the tissues, and will be compelled to sacrifice more of the foot than may be thought proper in order to secure sufficient amount of healthy tissue to cover the stump and leave the cicatrix on the dorsum; but this is an absolute necessity. Nothing can be more censurable than to make an amputation which will furnish a constant source of pain to the patient all through life, which will be certain if the cicatrix is on the palmar aspect of the foot. It is very seldom that an injury will be of such a nature as to require the removal of a single phalangeal bone, yet occasionally this may occur.

When this is necessary it should be removed in the same way as the corresponding parts of the hand. In removing a bone at the metatarso-phalangeal articulation the oval method is to be preferred, so that the sole of the foot may not be cut into. Many of the operations on the foot above described are not often applicable in the practice of railway surgery. The injuries which require amputation of the metatarsal bones, when caused by railway accidents, generally involve the whole anterior portion of the foot, and when an effort is made to save the foot an unsatisfactory stump will be the result.

## AMPUTATION OF THE ENTIRE METATARSUS.

When the injury is of such a nature as to justify the removal of the entire metatarsus, if sufficient healthy tissue can be secured from the plantar surface to make a covering for the stump, then the amputation known as Heys', or Lisfranc's amputation may be practiced

*Heys' Amputation* "is made by cutting a long plantar flap from without inwards, beginning at the outside of the tuberosity of the fifth metatarsal bone, cutting downward to the line of the metatarso-phalangeal articulation, then crossing the sole transversely in a curved line and passing up again to the inner side of the foot to the prominence of the scaphoid bone. The upper ends of this wound are united by a curved incision, convex downward, across the dorsum of the foot, making a short anterior flap. The four outward metatarsals are then disarticulated from the cuboid and external and middle cuneiform bones, and the projecting internal cuneiform cut across with a small saw."



Lisfranc's amputation differs from Heys' in being a pure disarticulation.

## AMPUTATION AT THE MEDIO-TARSAL JOINT.

This operation is known as Chopart's. In performing this operation the surgeon grasps the anterior portion of the foot with his left hand, and with a strong short knife makes a transverse incision, convex forward, across the dorsum, from a point half-way between the external malleolus and the tuberosity of the fifth metatarsal on the outside to a point about half an inch behind the prominence of the scaphoid on the inner side of the foot.

The plantar flap extends from the same point as far forward as the line of the metatarso-phalangeal joints. Disarticulation is rendered more easy by forcibly pressing the front of the foot downward, so as to make the anterior ligaments as tense as possible."

Various modifications of this operation have been recommended and practiced with good results.

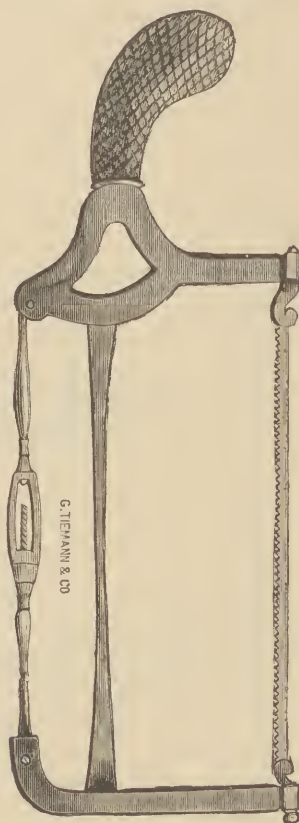
#### SYME'S AMPUTATION..

Mr. Syme, in giving a description of this operation, says: "In performing the operation, the foot being held at a right-angle to the leg, the point of a common short bistoury should



be introduced immediately below the fibula at the centre of its malleolar projection, and then carried across the integuments of the sole in a straight line to the same level on the opposite side. The operator having next placed the fingers of the left hand upon the heel and inserted the point of his thumb into the incision, pushes in the knife, with its blade parallel to the bone, and cuts down to the osseous surface, at the same time pressing the flaps backward until the tuberosity is fairly turned, when, joining the two extremities of the first incision by a transverse one across the instep, he opens the joint, and carrying his knife downward on each side of the astralagus divides the lateral ligaments so as to complete the disarticulation. Then the knife is drawn around the extremities of the tibia and fibula, so as to expose them sufficiently to be grasped in the hand and removed by the saw. After the vessels have been tied and before the edges of the wound have been stitched together, an opening should be made through the posterior part of the flap where it is thinnest, to afford a dependent drain for the matter, as there must always be too much blood retained in the cavity to permit of union by first inten-

tion. The dressing should be of the lightest character" (Observations on Clinical Surgery, page 47, Edinburg, 1861).



Mr. Syme gave this description before antiseptic dressings and precautions were introduced and practiced in surgical operations, and under the old method "too much blood was retained in the cavity to permit of union by first intention;" but under the improved method of dressing wounds we may expect, even in this operation, "union by first intention." This operation has been greatly modified, but it is doubtful whether any great improvements have been made over the original plan as given by Mr. Syme.



## PIROGOFF'S AMPUTATION.

This amputation consists in the removal of all the foot except the posterior part of the calcaneum, which is brought forward and placed in apposition with the sawn ends of the tibia and fibula, the articulating surfaces of these bones with the malleolar being removed. In making this operation an oblique incision with an anterior convexity is made across the plantar surface from one malleolar to the other, coming a little further forward on the inner than the outer side. This is done to avoid the posterior tibial artery. This incision must be carried to the bones and the flap dissected backward for about a quarter of an inch, when a second incision is made across the dorsal surface, also convexing forward, and crossing the ankle so as to expose the joint. When this is done disarticulation is effected, when a narrow-bladed saw is slipped behind the astragalus and the operator saws through the os calcis obliquely downward as nearly as possible in the line of the first incision. The next step in the operation is to saw off the ends of the tibia and fibula and ligate the bleeding vessels; after which the wound is closed by sutures and the stump dressed in the ordinary way.

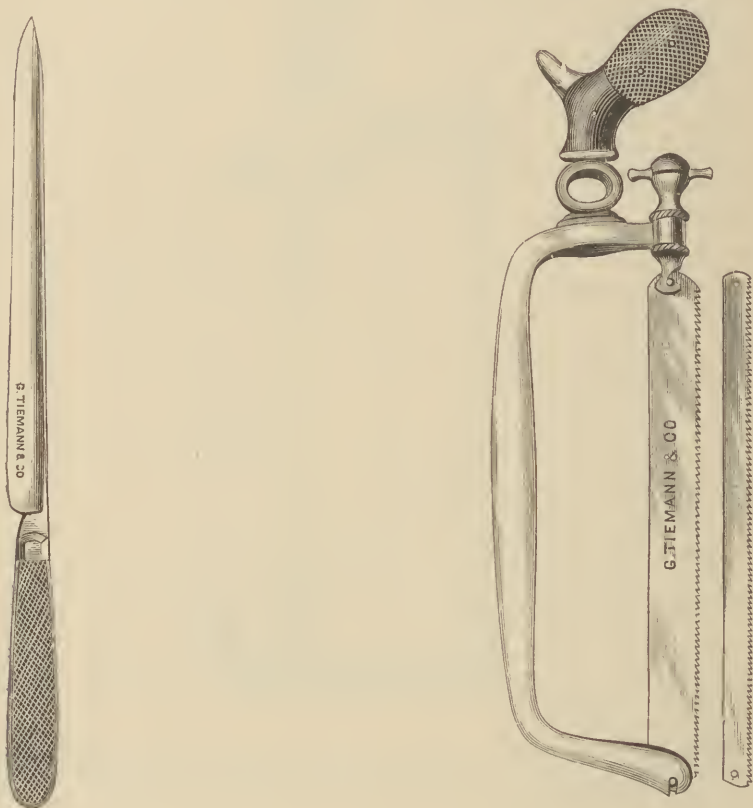
In a few cases of injury to the feet the writer has found this operation practical, but only in a few, for the reason that when the injury was of such a nature as to demand the removal of so much of the foot, where the injury was caused by the wheels of engine or car, the tissue was not sufficiently healthy to warrant this operation.

The following table, showing the results of amputations at the ankle, as given by Ashurst in the *Encyclopedia of Surgery*:

<i>Nature of Amputation.</i>	<i>Cases.</i>	<i>Deaths.</i>	<i>Per Cent.</i>	<i>Authority.</i>
Syme's Method,	338	28	8.2	Hancock, Spence, Fayne.
Pirogoff's Method,	273	28	10.2	Pirogoff, Weber, Kestnor, Hancock.
Not Specified,	358	101	28.2	Leyonest, Otis, Lenger.
Aggregates,	—	—	—	
	969	157	16.2	

## AMPUTATION OF THE LEG.

The amputation of the leg may be made at any part of the limb, through the upper, middle, or in the lower third. The method employed may be such as will suit the fancy of the



operator, as the success of the operation does not depend on the particular method employed. In this, as in other operations, there is some difference of opinion in regard to the method best suited to the amputation of the leg; some surgeons preferring the lateral flap, others the circular method, while many prefer the antero-posterior flap, and would recom-

mend this method to any other, but would advise that the posterior flap be made much longer than the anterior, especially in the middle and upper third. With this method a much better covering can be secured for the tibia than with any other method, and will make a much better stump than with either of the other methods. But in the practice of railway surgery the injury will frequently be of such a nature that the surgeon will have no choice as to the method, but will be compelled to modify the different methods and amputate so as to save as much of the limb as possible and secure a sufficient amount of healthy tissue to cover the bones, and it matters not whether he brings the flap from the lateral or posterior portion of the limb so he has sufficient healthy tissue to cover the ends of the bones and secure for the unfortunate injured a good stump.

The operation known as Siddillot's, or the external flap method, is described by Ashurst as follows: "This is the operation I prefer to all others in the amputation of the upper part of the leg. A longitudinal incision through the skin is made along the inner edge of the tibia; the tissues being drawn to the fibular side of the limb the longitudinal incision gapes sufficiently to allow a slender catlin to be introduced close to the outer edge of the tibia, made to graze the fibula and to be brought out posteriorly, transfixing the limb on the outer side of both bones. The knife is then carried downward close to the bones with a sawing motion and then made to cut its way outward, forming a broad, rounded flap.

The tissues on the inner side of the limb are next divided by an incision somewhat convex anteriorly and the bones then cleaned by a circular sweep of the knife. The osseous membrane being divided, all the tissues are pushed upward with the hand or the handle of the knife so as to expose the bone about an inch higher up before the application of the saw."

In the sawing of the bones it is suggested by some surgeons that both bones should be separated simultaneously and on the same level, but experience has taught the author that it is better to divide them separately, and to remove half an inch more

of the fibula than of the tibia. In all amputations of the leg the spine of the tibia should be carefully rounded off with the bone pliers before covering it with the flaps. There will be



found three arteries requiring ligation; the anterior and posterior tibial and peroneal, and sometimes two or three muscular and cutaneous branches which may require a ligature.

The dressing of the stump is the same as that of any other, requiring the same precautions in covering it with the antiseptic gauze, compresses and bandages.

#### TEAL'S AMPUTATION OF THE LEG.

The lower third of the leg is the most favorable for Teal's method. The operation is the forming of a long and short rectangular flap. The long flap should be cut from the part of the leg which contains few bloodvessels and nerves. This operation may be useful in some cases of railway injuries, where, as is sometimes the case, the tissues are uninjured on one portion of the leg, and in bringing the flaps from the healthy portion much of the limb can be saved; but where it can be done the ordinary flap method or the circular are to be preferred to that of Teal's.

Teal requires that the flap should be perfectly square, and that its length and breadth be each equal to half the circumference of the limb at the place where the bones are sawed off. The short flap is required to be one-fourth the length of the long one. It is usual, before cutting these flaps, to mark out the line of incision with ink, tincture of iodine or pencil, to secure accuracy in their construction.

After the flaps have been formed the bone is to be sawed off and the vessels ligated, the long flap is brought over the end of the bone and attached by sutures to the short flap.

The sides of the two flaps should be connected with sutures as well as the contiguous edges of the long flap.

There are serious objections to this method in accidental surgery. One objection is that of tracing the lines of incision with ink or iodine preliminary to the making of the operation. But the most serious objection is the extensive division of tissue which is required in this operation, as in most cases of injury requiring amputation the surgeon will not have the healthy tissue required in making the long flap unless the injury is to one portion of the limb.

Another objection is that it is more difficult to heal than either the flap or the circular operation.

#### AMPUTATION AT THE KNEE-JOINT OR THE KNEE.

Amputation at the knee-joint is where there is a disarticulation at the knee when there is a portion of the femur removed; that is, of the condyles.

*Amputation at the Knee-Joint.*—This operation is best made by the flap method, on account of the irregular shape of the parts, and most operators give preference to the anterior flap (Fig. 193, Enc. of Surgery).

*Lateral Flap Method.*—This operation is made by forming the flaps from the side of the leg, the cicatrix being placed between the two femoral condyles. The advantage claimed for this method is that convenient means are afforded for drainage, while the natural coverings of the knee are not interfered with. Some authors recommend that in this operation the patella should be removed, but the author does not agree with this recommendation, and would advise that it be retained, as it adds greatly to the symmetry and firmness of the stump.

The articular cartilage should be removed, both of the patella and of the femur, for the reason that it will exfoliate and become a source of irritation. The older surgeons suggested that "it would exfoliate and come away with the discharge," but we do not expect any discharge under the improved method of operating, consequently it had better be removed with

the knife, which can be easily done without the use of a saw.

*Amputation at the Knee.*—This amputation differs only from that of the knee-joint in this, that a portion, more or less, of the end of the femur is removed by sawing through the condyles. The same method may be practiced in this as the former (Fig. 194, Enc. of Surgery).

#### AMPUTATION OF THE THIGH.

The amputation of the thigh may be performed by any of the methods named, but in this, as in almost all cases, the writer gives the preference to the antero-posterior flap operation (Fig. 195, Enc. of Surgery). But the railway surgeon cannot always select the method he may prefer, consequently the modified circular operation or the lateral flap method may be adopted.

#### AMPUTATION OF THE HIP-JOINT.

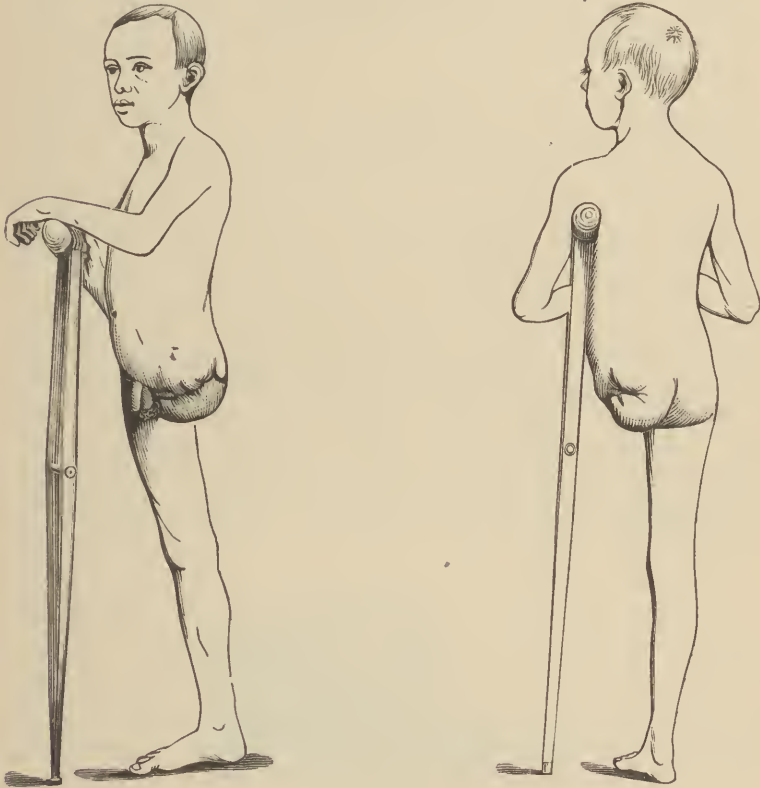
This amputation has always been regarded as the most serious operation the surgeon is called upon to perform, and, in fact, the mortality attending it is so great that many surgeons still regard it as not justifiable; but with the improved method of operating and dressing wounds we believe it to be entirely justifiable, and no surgeon should hesitate to make it whenever an injury is of such a nature as to demand it.

Dr. J. E. Russell, of Springfield, Ohio, in a paper read at a meeting of the Pennsylvania Company's surgeons, May 15, 1888, reported the following case: "Thomas Griffin, æt. 12 years, with a party of boys had been swimming in a hole near a switch track of the I. B. & W. R. R.

"The boys were chasing each other around the cars, and Thomas jumped on the brake-beam of the rear end of the last car. The switchman let down a 'cut' of cars and the boy was knocked off, falling with his back on the rail. The car wheel ran upon the boy close into the left groin, the flanges of the wheel cutting the tissues from the symphysis-pubis so that the



intestines protruded. The broad part of the wheel crushed the femur near the great trochanter, and mashed the tissues into a jelly. When called to the boy I found the shock very profound. I administered the A. C. E. mixture and was soon dis-



joining the crushed femur at the hip-joint. The intestines were returned, the wound sutured, the arteries ligated, the mangled flesh cut away and the wound cleansed of cinders, coal dust and dirt. It was a tedious task; so much space to cover and so little tissue to utilize. When the wound was fairly dressed, and the anesthetic discontinued, the patient made good advancement from shock. The wound healed very kindly."

Here was one of the severest surgical injuries dressed without regard to shock. To wait for reaction in such a case would be culpable neglect.

Other cases could be mentioned where the operation was successfully made with a speedy recovery of the patient. There are various methods for making this operation. They are so very numerous that we shall not attempt to give all of them.

*The Antero-Posterior Flap Method.*—Of this there are three varieties, known as the Liston, Beelard and Guthrie.

The Liston method is that of making the anterior flap first, by introducing the point of a long knife between the great trochanter and the anterior spinous process of the ilium, carried over the anterior portion of the femur and brought out just in front of the tuber ischia, and the knife carried downward and outward, making a flap about nine inches in length, then disarticulating the joint and making a posterior flap from the buttock and tissues on the back of the thigh.

In Beelard's method the posterior flap is cut first. The knife enters just above the trochanter and is carried across the limb, hugging the back of the neck of the femur, and is brought out at the innermost part of the gluteal crease. The knife is then carried downward and outward to form a flap from the tissues of the buttock. The anterior flap is then made by introducing the knife at the same point as before, pushing it across the anterior portion of the bone and cutting the same as before, making a corresponding flap, when disarticulation is effected, this being the last step in the operation.

Guthrie's method is much the same as the former, except that the flaps are made by cutting from without inward, and the posterior flap made first. This makes a good stump. The great danger in this operation is that of hemorrhage, and many methods have been suggested to prevent the serious loss of blood in making this amputation.

Dr. J. J. Buchanan, of Pittsburg, Pa., suggested, in a paper read at a meeting of the surgeons of the Pennsylvania Company, at Pittsburg, in October, 1888, the propriety of making

an abdominal section under strict antiseptic precautions, and having an assistant introduce the hand and compress the descending aorta while the amputation was made, and thus prevent the great loss of blood. The suggestion was received with favor by the surgeons present, and it is believed that under very careful antiseptic precautions there could be no objections to this procedure. The additional shock occasioned by the abdominal section could not be as great as that of a few jets of blood from the femoral artery, as this will certainly endanger the life of the patient. We believe this preferable to Larray's method of cutting down and ligating the main vessel in the groin as a preliminary to the operation. The compression of the vessel with the aortic tourniquet has not always been successful, and, in fact, all mechanical means have failed, and the compression of the nervous structures of the abdomen cannot help but be harmful, in fact, more so than would follow an abdominal section. It is claimed that if the patient is thin that manual compression can be successfully employed over the external iliac or over the common femoral. The aortic compressor, the rubber band and manual compression have been mostly employed. Before beginning the operation the blood should be forced out of the limb by the use of the Es-



march bandage, so that the patient may have in reserve the surplus quantity of blood which can be stored in the opposite limb and upper extremities until it will be required for the general circulation. This can be accomplished by placing the bandage around the thigh and near the shoulders, so as to act as a mechanical obstruction of the venous circulation, while the

deep arteries will carry the blood into those extremities, where it can be retained until the amputation is made, when the bands can be removed and the blood permitted to return to the general circulation, and, in fact, if the patient has lost much blood, the application of the Esmarch bandage to the extremities is suggested, thereby forcing the blood into the body until reaction is fully established. The author has, in a number of cases where patients have lost large quantities of blood, forced the blood out of one or two extremities and held it there for more than one hour, when the patient would rally under the use of proper restoratives; then the bandage would be removed, and in no case have any bad results followed its use. There is no danger in applying the Esmarch bandage and allowing it to remain for more than one hour, in fact, the writer has allowed it to remain for two hours in several cases, and believes that he has saved life by so doing.

The hand of a reliable assistant should follow the knife of the operator, and at once compress the artery and hold it until it can be ligated. A large sponge or compress should always be at hand, so that the flap can be compressed, or at least while the surgeon is ligating the vessels, and thus prevent the loss of blood. If these precautions be observed and improved methods of antiseptic procedure carried out, the number of fatal cases resulting from hip-joint amputations will be greatly lessened.

After the operation the stump should be dressed antiseptically and the patient placed in bed surrounded with bottles filled with hot water. In all serious operations the bed in which the patient is to be placed should be thoroughly warmed by hot irons and bottles filled with hot water before he is placed into it; and this artificial heat should be continued until reaction is fully established.

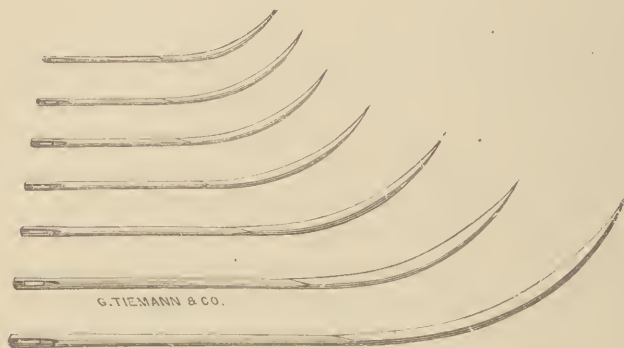
#### OPERATION.

The surgeon should have everything prepared and in readiness before he begins the operation. The first thing to do

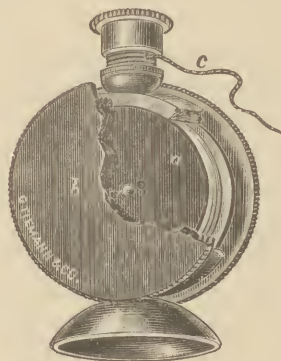
will be to prepare the patient. If opium has not been already administered, he should have at least one-fourth of a grain of the sulphate of morphia and the one-sixtieth of a grain of the sulphate of atropia, administered hypodermically. This is the best method of administering it, for the reason that the condition of the stomach is such that it will not readily appropriate it. By giving it hypodermically it will soon have the desired effect, and will aid very much in bringing the patient under the influence of the anesthetic; and will also aid in bringing on reaction. If the nerves can be quieted and the patient relieved from pain, reaction will be established much earlier. After giving the hypodermic injection the parts to be amputated should be thoroughly cleaned by shaving all the hair off the limb and washing it carefully with soap and water, using the flesh brush. This is a preliminary of the greatest importance.

After having thus cleansed the parts they should be thoroughly irrigated with carbolyzed water and with a solution, one to one thousand, of the bichloride of mercury. Towels should be immersed in this solution, and before making the amputation they should be wrung out and the parts above the point of amputation carefully covered, and also the body and clothing of the patient. The surgeon and his assistants should also cleanse their hands in the same manner as directed in preparing the patient. No one should be permitted to assist in the operation who has not carefully washed his hands with soap and the bichloride solution. With these precautions there will be no trouble in making what is known as the antiseptic operation, even in a private family, boarding house or hotel. The operator should see that every instrument that may be required is at hand. He should mentally go through the successive steps of the operation and lay out in proper order every instrument that in any emergency might be necessary, even to the minutest detail, and know that each one is in good condition. Ashurst says: "There can be nothing more awkward than for the surgeon, after making his flaps, to discover that the saw has been forgotten, or, when the limb has been re-

moved, that he is likely to run short of ligatures or that the needle with which he proposes to sew up the wound has no



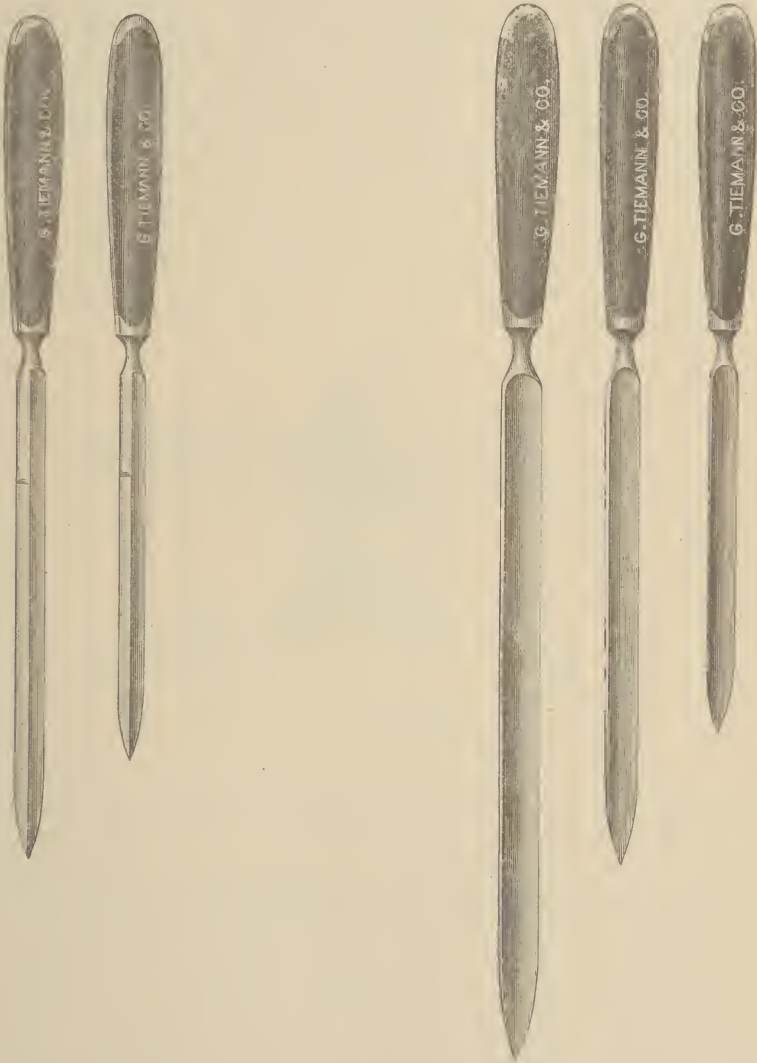
point or a broken eye. Nor is the inconvenience to the operator the worst result of this kind of improvidence, for delay caused in producing the missing articles may prove very prejudicial to the patient." All the instruments necessary for the operation should be carefully selected and placed in a five per



cent solution of carbolic acid so that they are completely covered. The water should be warm and no instrument used unless taken out of the vessel containing the antiseptic solution. The carbolic acid is preferred to the bichloride solution for the



reason that the latter tarnishes the instruments while the former does not, and is equally as good. We include in this the



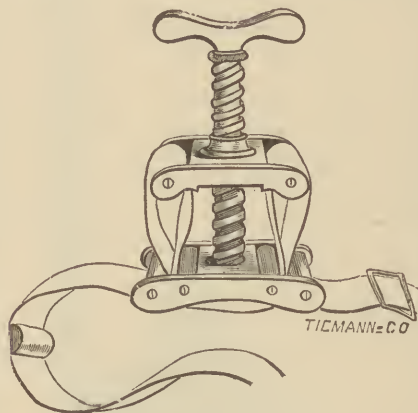
needles, ligatures, sutures, and, in fact, every instrument or appliance to be used must be carefully and thoroughly disinfect-

ed. The instruments necessary for an amputation are a good Esmarch bandage with an elastic band or tube or a tourniquet, a complete set of amputation knives, bone forceps or cutting pliers, a pair of strong forceps for holding the bone, a Spencer Wells or some other good artery forceps, ligatures, sutures, needles, scissors, small dressing forceps and terracula.

Also a good supply of antiseptic gauze, iodoform bandages, protective silk, oiled silk, pins, etc.

#### TO CONTROL HEMORRHAGE.

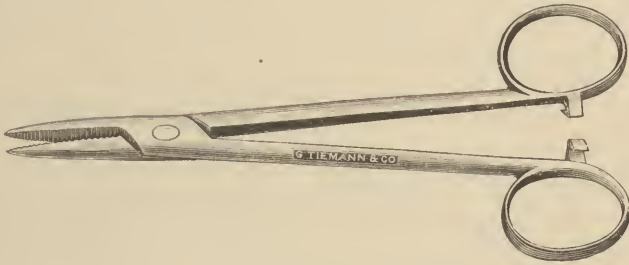
Many good surgeons prefer the tourniquet to the Esmarch



bandage, as a means of controlling the hemorrhage, but the experience of the author has been in favor of the bandage, having used it in more than two hundred cases during a period of more than twenty years without noting any bad results following its use. When a patient has already lost considerable blood the surgeon should prevent, if possible, any bleeding during the operation, and in no way can this be more certainly prevented than by the use of the Esmarch bandage. The Spencer Wells artery forceps are also very useful in clamping any bleeding vessel and holding it until the operation is completed.

## THE METHOD OF APPLYING THE BANDAGE.

After the limb has been thoroughly cleansed and disinfected the bandage, having first been placed in a five per cent solution of carbolic acid, should be applied, beginning at the distal end of the limb and drawing tightly so that the blood in the limb may be forced out of the tissues and parts to be amputated. No fears need be entertained of forcing coagulated blood into the healthy tissues, as this cannot be done. The bandage must be carried above the point where the amputation is to be made. When the bandage is so applied a rubber



band, which is preferable to the solid or hollow rubber tube, is then applied sufficiently tight to prevent any arterial circulation. The bandage is then removed and the limb washed with the antiseptic solution before the amputation is made.

Ashhurst, in the "Encyclopedia of Surgery," says: "The bandage is accurately applied to the limb upon which the amputation is to be made, from below upward, and with sufficient firmness to render the part quite bloodless. The elasticity of the bandage renders it unnecessary to make reverses, and with little care the whole extremity can be covered without leaving any gap between the turns. The tube, which may be either round or flattened, is next wound firmly four or five times around the limb at the point of termination of the bandage, and is secured either by tying or hook and chain. The bandage being then removed the part is left fully exposed and entirely free from blood. Objections have been

urged against the use of the rubber bandage, that by the pressure clots might be dislodged and forced up into the veins, causing pulmonary embolism and death. Other surgeons object to the employment of the bandage, because of the liability to consecutive hemorrhage and it is claimed that unless special precautions be observed, free capillary oozing will certainly follow when the tube is removed; and that in some cases this has proved a very serious complication. No such complication has ever followed its use in the large number of cases where the author has employed it. The tube should be hollow, or what is better a flattened bandage and not a rubber cord, and after it is removed, and before the flaps are brought together with the sutures, the limb should be carefully rubbed with the hand or a rough towel, so that the circulation may be thoroughly established. If this precaution be taken no bad result will follow the use of the bandage. A hard rubber band or cord should never be employed. The tourniquet mostly employed is that introduced by Petit. This consists of two metal plates which are regulated by means of a screw and are connected by a strong strap, which passes around the limb and is fastened with a buckle. A small compress is fastened to the strap, which is placed over the artery, and then the screw tightens the band, and in this way the artery is compressed. There are many other instruments employed for the purpose of controlling hemorrhage. The field tourniquet, which is found in many of the amputating cases of instruments, is not a good instrument, but rather a dangerous one, for the reason that, while it may control in part the arterial circulation, through the limb, it in almost all cases causes venous hemorrhage. The best apparatus known to the author is the Esmarch bandage, with the flattened band. Dr. W. W. Dawson, of Cincinnati, Ohio, says: "The best stimulant that he can give to a patient, that has lost considerable blood, is to force the blood out of the limb to be amputated into the general circulation, by the employment of the Esmarch bandage."

## ANESTHETIC.

Before commencing the operation, that is, before the Esmarch bandage is applied, unless there should be much bleeding, the patient should be given an anesthetic. In another chapter we have referred to the relative value of the different anesthetics, giving the preference to sulphuric ether, and prefer Squibbs' stronger ether for anesthetic purposes to any other. The employment of the A. C. E. mixture is highly recommended by some surgeons, and others still, prefer chloroform, but the ether is certainly to be preferred to all other anesthetics, as being much safer and, when properly administered is almost as certain as chloroform or the A. C. E. mixture.

## MODE OF ADMINISTERING ANESTHETICS.

The patient should always be placed in the recumbent position; all the clothing should be loose so as not to interfere with respiration. Many complicated apparatuses have been invented, for the administration of anesthetics, but the



majority of them are useless. One great objection to all such apparatuses is that they soon become filthy, and if we will apply the golden rule to our patients, to "do unto others as we

would have them do unto us" we certainly will not employ them, for no surgeon would like to have an inhaler which has been used in the treatment of a syphilitic or tuberculous patient, saturated with the sputa, and frequently with the rejected ingesta, to be placed over his mouth and nose; it is not only filthy, but we regard it as dangerous. The most convenient and best and safest is a good clean napkin or towel, which every railroad surgeon should have with him in his general emergency case. While the anesthetic is being administered, there should be perfect quiet in the room. All loud conversation should be avoided, and the most careful attention given to the patient, and any symptoms of danger carefully noted. In order to avoid coughing when ether is administered, it should first be given in small quantities for a few minutes, when the mucous membrane of the air passages will become accustomed to it without producing that peculiar sensation of suffocation which causes the patient to struggle and endeavor to escape from the operating table. After a few minutes the quantity can be safely increased, and the patient be brought completely under its influence without the least struggling or coughing. In railway or accidental surgery we cannot, as a rule, wait for the stomach to become empty of food, for the reason that in many cases the accident may have taken place soon after having partaken of a hearty meal, and of course while the patient is suffering from the shock of the accident, digestion is completely arrested, but fortunately in such cases vomiting will frequently empty the stomach even before an anesthetic is administered, but if it is not it is certain to follow the administration of it, frequently greatly interfering with rapid progress in the operation.

#### DIFFERENT METHODS EMPLOYED IN AMPUTATIONS.

Surgeons greatly differ in the methods employed in amputations. Some prefer the circular to that of the flap operation. Prof. W. H. Gobrecht, M.D., who was one of the leading surgeons in the war of the rebellion, always preferred the



circular operation, and claimed for this method that in transporting the injured, there was less risk than when the flap operation had been made. Other surgeons with equal eminence in the profession claim that the flap operation is equally as safe as that of the circular. There are many modifications of these two methods but we shall only refer to the two, the circular and the flap.

The circular operation is made by bringing the patient to the foot of the table; the patient should always be put upon a table, and not attempt to operate on a bed or lounge, or on the floor, as the author has been frequently requested to do. A table can always be provided. If in a house the ordinary dinner table can be used. If too short a stand can be placed for the head to rest upon until the patient is under the influence of the anesthetic, when a very short table will in most cases answer the purpose, especially if the amputation is to be performed on one of the lower limbs. A few old quilts or comforts spread upon the table with a pillow will make a good operating table, and is much to be preferred to the bed or lounge. The patient is then brought to the foot of the table, if the amputation is of a lower limb, so that the parts, where the amputation is to be made, is entirely free from the table. A tub or bucket should be placed near the end of the table to catch the blood. The circulation having been controlled, by the Esmarch bandage or the tourniquet (if the latter is employed the surgeon should know that the compress is on the artery), the instruments being placed in a tray and put in reach of the operator, so that he can select any instrument he may desire without asking for it, one assistant takes hold of the limb and places it in such position as the operator may direct, and at the same time is watchful that the uninjured limb is not in danger from the operator's knife.

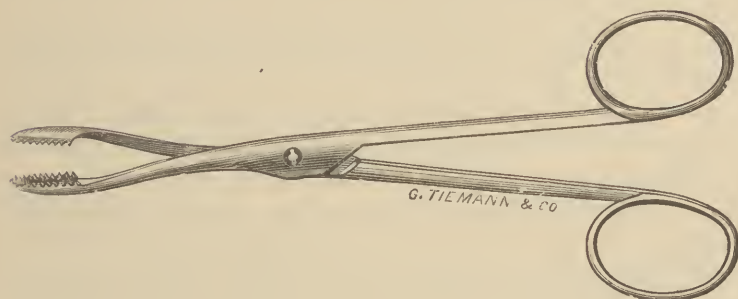
In making the first incision for the circular operation, the surgeon should grasp the limb above the point of amputation, holding it steady, and at the same time draw the skin upward, with his left hand. He then carries his right hand, holding the long knife, around the limb so that the back of the knife shall

be directed towards his own face. Cutting with the heel of the knife, he then makes a circular sweep around the limb, rising as he does so and thus completing the whole of the cutaneous incision with one motion. Should the skin at any point adhere he must loosen it with a scalpel or with the same knife, and retract it, if necessary dissecting it upward from the muscles, so as to make a cuff half the size of the limb. When the skin has been dissected back, and retracted sufficiently high, the surgeon will again apply the knife the same as before and cut through the muscles down to the bone. The muscles will at once retract and leave a wide gap, but it will be necessary to separate their attachments from the periosteum and to push them back. This can best be accomplished with the fingers or with the handle of the knife. After the muscles have been severed from the bone to the extent of at least two inches where but one bone is involved, and, where there are two bones, after the interosseus tissues have been divided by the use of the double edged catlin or scalpel, and the adjoining surfaces of bone cleaned in the method just described, a retractor is then applied, as follows: A strip of muslin, having previously been immersed in the bichloride of mercury, is torn into strips, if the amputation is in the forearm or leg, and the middle strip is thrust between the bones and the other two are brought around the cut surfaces so as to cover the muscles and integuments, when an assistant will take hold and retract, thus protecting the muscles from the bone dust produced in severing the limb.

In sawing the bone the operator should set the heel of the saw at the highest point drawing it backwards quite slowly in order to make a groove for the saw in its forward movements. If two bones are involved in the operation they may be divided simultaneously in many cases, but if this cannot be done the smaller one should be divided first. If in the leg it will be well to divide the fibula about one-half inch above the tibia. After the limb has been separated the next step is to remove any spicula of bone or any sharp points with the bone pliers. Especially is this required when the opera-

tion has been made through the leg, when the spine of the tibia should be carefully rounded off.

The surgeon will give attention to the blood vessels. If he has at hand a number of Spencer Well's artery forceps he will



grasp the vessels and fasten the forceps, and allow them to hang until all the vessels are secured, when he will proceed to ligate or use torsion. In the West Pennsylvania Hospital, at Pittsburg, the surgeons rely entirely upon torsion, and have not for fourteen years used a single ligature. The writer has not relied on this method but has always ligated the larger vessels. The material used of late years has been the animal ligature, first using torsion and then applying the carbolized catgut.

A word of caution will not be out of place here in regard to the use of the catgut in ligating important blood vessels. If torsion is not employed before the catgut is applied there is some danger of subsequent hemorrhage, resulting from the early giving away of the ligatures. This has occurred in a few cases and their use is not recommended without first employing torsion. The silk-worm gut is quite extensively used in this country and also in Europe, and is certainly more reliable than the catgut. The silk ligature may be employed and allowed to remain, without even producing irritation. The preference is given to catgut, first employing torsion. During the time the arteries are being secured the stump should be constantly irrigated with the one thousand bichloride solution,

the water used being quite hot. This will aid in the arrest of all capillary oozing. Should there be much venous bleeding the veins should be ligated. No fears need be entertained of phlebitis following this treatment as was formerly supposed. No styptic, such as Monsell's solution, tannic acid or styptic cotton, should ever be employed.

Hot water will do more to arrest the venous and capillary oozing than any styptic application. The stump should not be closed until all bleeding has ceased. An essential precaution is that the parts should be constantly irrigated with the bichloride solution.

After all bleeding has ceased the skin or cuff is drawn down over the stump and the wound is closed with sutures. When considerable time has elapsed from the time of the accident to that of the operation, and where there has been much swelling of the parts, the tissues being filled with serum, a calcified bone-drainage tube should be placed in the wound so the fluids can easily escape. In some cases where the operation is delayed for more than twenty-four hours from the time of the accident large quantities of serum will escape from the wound for several days after the amputation is made, rendering drainage quite necessary.

#### THE DOUBLE FLAP OPERATION.

In this method of operating the surgeon with his left hand grasps and raises the tissues from the bone; the skin being retracted by an assistant, he introduces the long pointed knife at the side of the limb which is nearest to him, pushes it through, closely hugging the bone, and brings the knife out at a point diametrically opposite to that at which it entered. He then makes a sawing movement of the knife, carrying it downward and outward.

The flap should have a length at least two-thirds the diameter of the limb. The surgeon now re-enters the knife at the point where it first entered and, passing now on the other side of the bone, is brought out at the same place as before. The second flap is then made in like manner as the first.

The author's method has been when the flaps are made antero-posteriorly to make the anterior flap first. The rule as given by the text-books is to cut the flap containing the most important blood vessels last. We have always given preference to the flap operation but in accidental surgery, and especially in railway injuries, the surgeon is not at all times at liberty to choose, but must make his flap to suit the healthy tissues.

Dr. Russell, in his able paper on this subject, says: "Having reviewed the surgical works on this subject you perceive that the pictures are by no means an illustration of what you had before you. This is a stern reality; there is no escape, no opportunity to look around you and wish your professor were present to assist. There is no apology for the young surgeon having a shock half as severe as the patient, although he may feel it coming on. If the hand trembles and the knife point does not strike the exact place where you are looking, that makes no difference. The knife once boldly plunged into the tissues the shock of the timid surgeon is all over. Every case requiring an operation must be a law unto itself." As already suggested we must make the stump out of such healthy tissues as we may have, and consequently no exact method can be outlined. We may remember the most excellent wood cuts, illustrating the different methods, but these will be of little benefit in the great majority of cases requiring amputation, in railway injuries. The good judgment of the operator must decide the method at the time, and he dare not rely on what the text books teach.

After the flap has been made the same precautions relative to severing and detaching the muscles from the bone as noted in reference to the circular operation, must be observed by passing the knife around the bone and carefully cutting away all muscular attachments before applying the saw. The ligating of the vessels and cleaning the wound is the same as already prescribed for the circular method. It is not deemed necessary in this work to reproduce the methods known as Teal's, Sedillot's and Longenbeck's.



The flaps should now be brought together with either the catgut, silkworm gut, horse hair or silver wire suture. The edges of the wound should be made to approximate evenly.

It has been our practice to place a bone drainage tube next to the bone and cover it over with the muscular tissue, held in place with a few deep sutures, using the catgut for this purpose; then bring the flaps together and close the wound, using the interrupted suture and generally employing the silk worm gut or the horse hair. The wound is then covered with Lister's protective, the antiseptic gauze and iodoform. The stump should be covered with many layers of the antiseptic gauze and the latter covered with a roller bandage which has also been disinfected by placing it in the bichloride solution.

After the dressing has been completed with the bandages the stump should be covered with oil silk. The dressing thus completed the patient should be at once placed in bed, and if the shock has been great artificial heat should be applied to the body and extremities and as soon as it can be taken a cup of warm coffee given. The dressing of the stump should not be removed for ten days or a fortnight, unless there should be a rise of the temperature above  $103^{\circ}$ , or if there should be much discharge of serum from the wound and the dressing becomes offensive. Whenever it is necessary to remove the dressing it should be done under the irrigation of the bichloride solution, and this be continued until the redressing is completed in the same manner and with the same precautions observed in the first dressing.

We have in many cases allowed the first dressing to remain undisturbed for fourteen days and when removed have found complete union without any pus.

In railway accidents we have occasionally to amputate two or more limbs at the same time. The following case of rare simultaneous triple major amputation is reported by John Ashhurst, Jr., M.D.

"Patient, a Moor, æt. 20 years. He was admitted to the University Hospital November 28, 1887, having been run over on the Pennsylvania railroad. I saw him within two hours



after his admission. I found a compound comminuted fracture of the right leg, the laceration extending above the knee; complete avulsion of the left leg, the limb having been torn off in its lower third; and a compound fracture of a severe character of the right hand and wrist. There was also a compound fracture of the skull involving the frontal bone. This, however, was an impacted fracture of course without much depression, and did not require interference. In addition to these injuries there are numerous brush-burns and contusions, some of a grave character. One on the left buttock was so severe that the separation of the slough left a cavity fully two inches deep. Notwithstanding these serious injuries, the patient's general health was very good; he had reacted thoroughly and his axillary temperature was 99°F.

"Under these circumstances I felt justified in proceeding to the immediate removal of the injured limbs, and amputated successively the right thigh, by the antero-posterior flap method; the left leg about its middle, by a modified Sedillot's external flap operation, the modification consisting in making both flaps from without inward, instead of cutting the external flap by transfixion; and the right forearm by an oval incision, making use of the uninjured skin of the back of the hand and wrist. Certain variations from the ordinary procedure in amputations I shall refer to when I come to speak of what I venture to term the technique of multiple amputations. After the operations were completed the temperature had fallen to only 98° F. The patient had no bad symptoms and rapidly recovered, and he is entirely well. I have collected some statistics of synchronous multiple amputation. I am able to find but one instance of quadruple synchronous amputation a case in which the operation was done for frost-bite by Dr. George E. Jackson of Dakota. There are several cases of quadruple amputations recorded, not synchronous, the one which approaches nearest to a synchronous operation being that of Champenois, a French surgeon, who amputated three limbs on one day, and the fourth a few days later.

"Of synchronous triple amputation there have been reported

four successful operations, not including the case now presented; one by Dr. Kohler, of Schuylkill Haven, Pa., and two referred to by Prof. Agnew, in his Surgery, one occurring in the practice of Dr. Stone, of New Orleans, and the other in York, the name of the surgeon not being given. There are reported four or five triple amputations not synchronous. I have myself resorted to synchronous triple amputations in two cases. Several years ago I had occasion to perform this operation, removing both legs and the right forearm of a man, *æt.* 45 years, of intemperate habits. The patient died on the tenth day, the fatal result being due rather to the visceral lesions resulting from alcoholism than to the operation.

"Double amputations are comparatively numerous. I have personally performed fifteen such operations, this number not including two successful cases of double partial amputation of the feet. I have done fifteen double amputations, of which five have ended in recovery.

"In the fatal cases seven of the deaths occurred within less than a day, and were, therefore, the immediate result of the shock of the operation. Three patients died, one in three days, one in four days, and the third in eighteen days. The latter would probably have recovered but he also had suppurative disease of the middle ear, which appeared to be the cause of the pyemia, which proved fatal; for when the stumps were examined after death, they were found to be in good condition."

As further interesting citations on this subject we give the following cases, reported by James Buckner Luckie, M. D., of Birmingham, Ala., at a meeting of the National Railway Surgeons' Association, at Chicago, June 28, 1888:

"Case I.—On the morning of October 1, 1886, Dock Wright, colored, *æt.* 21 years, was run over by a switch engine. I saw him at six o'clock, about half an hour after the accident. I found the left foot and arm literally crushed to pieces, the injury extending into and a little above the joint; the right foot and ankle, hand and wrist similarly mangled. Also a wound near the region of the left kidney, into which I could thrust all the fingers of my hand to the depth of nearly two

inches; also a scalp wound three inches long on the left side of the head, and abrasions and contusions on nearly every portion of the body. He was greatly collapsed; pulse barely perceptible at the wrist. I at once injected half a grain of morphia in the arm, applied dry heat to the body and administered a large dose of whisky. At eight o'clock, finding that reaction had taken place, I had him removed to a boarding house and made preparations to amputate. One hour later, assisted by Dr. B. G. Copeland and such assistance as we could pick up in the emergency, I began to operate. Desiring to be as quick as possible, I requested Dr. Copeland to operate on the left thigh while I operated on the right leg and arm. Each of us applied an Esmarch bandage as soon as the patient had gotten well under the influence of the ether and commenced to operate, applying our knives at about the same moment. Dr. Copeland amputated the left thigh at the lower third, whilst I amputated the right leg at its lower third and the right arm at its lower third. We experienced no difficulty in taking up and tying the blood-vessels. The stumps were quickly dressed, as were the other injuries, and the man placed in bed and made as comfortable as possible. For the first three days he was very weak and we feared a failure of the heart's action; however, he rallied, and after that did well, growing fat each day. His greatest suffering was from the wound in his back; this, however, did well and was nearly healed as soon as the stumps.

"He hardly gave a thought to the scalp wound. The only trouble we had with the stumps was that it was necessary in about two months to remove a button of the bone from the right leg.

"The modified circular operation was adopted in all three of the amputations. The man made a rapid recovery and is now living at Montgomery, Ala., and is well and hearty."

"Case II.—On the morning of December 11, 1865, I was called to the Pioneer Company's Works, three miles from the city, to see J. McKnight, white, æt. 32 years, who had been crushed under the wheels of a car loaded with building material. Upon questioning the messenger I found that the injur-

ies were very similar to those in the case reported above, and that probably a similar operation would have to be performed. I at once sent for Dr. Copeland, who so ably assisted me in the former case, and requested him to accompany me. Upon arriving at the house where the wounded man lay, I found both legs horribly crushed up into and a little above the joints, and the right arm crushed into a mass from the tips of the fingers to above the elbow.

"Some one had given him a dose of morphia and a stimulant, and he was resting passably well; pulse a little feeble, but regular. Assisted by Dr. Cunningham, of Pratt Mine, and such help as we found present, we at once made arrangements to operate. Dr. Cunningham administered the ether. As soon as the man was thoroughly etherized we applied our Es-march bandages and operated as in Case I, Dr. Copeland taking the left and myself the right side. Dr. Copeland amputated the left thigh at its middle third, whilst I amputated the right at the juncture of the middle and lower third. So simultaneously did we amputate that after I had sawed through the right femur I did not lay down the saw, but reached over and sawed the left for Dr. Copeland. After tying the vessels I then amputated the right arm at its middle third. We dressed the stumps as quickly as possible and placed the man in bed.

"He came from under the influence of the ether badly, and for a while we had grave fears as to the result. He, however, rallied and steadily improved day by day. He convalesced without any trouble whatever, except from the stump of the left thigh; upon removing a button of dead bone all trouble was remedied.

"The operation the same as in Case I, the modified circular.

"The man is now living and is hale and hearty."

#### AN UNUSUAL HEALING PROCESS.

Dr. N. J. Pettyjohn, of Kansas City, Mo., reports the following cases:

Those of you who take an interest in the science of our profession, as distinguished from its art, will doubtless call to mind how very little is to be found in standard literature on surgery, in the healing process after an amputation.

We say: "We amputated by such a method, the ligatures came away at such a time, and the granulation tissue united satisfactorily," and we are content. When this process varies, as for instance in the case set forth, we are compelled to demand, "What is that we have not accounted for?"

On the third day of December, 1888, a brakeman, W. L. Richards, an employe of the Kansas City, Fort Scott and Memphis railroad, fell from a car, and his right arm was run over and crushed. Previous to this accident he was a sufferer from a chronic cough with more than a suspicion of a lung trouble, some reason being seemingly present for the belief that a diathesis existed far more favorable for the formation of inflammatory products than was at all desirable.

Immediately after the accident Richards was taken to Thayer, Mo. Amputation was performed by Dr. Powell, the division surgeon at that point. In his report to headquarters the narration is as follows: "Richards' arm was utterly disintegrated, so amputation in the upper portion was determined on. Amputation in the middle third by circular method. There was much capillary bleeding; capillary congestion including the lungs was marked." Dr. Powell forwarded the case to Kansas City the day after amputation, and it went into the hospital. The day following his arrival, in consequence of the soiled condition of the dressing put on at Thayer, I redressed the stump, using all possible precaution for the purpose of avoiding trouble by the blood loss which I feared, or by infection. This dressing remained in place until the sixth day. On the sixth day I dressed again, and found when the dressing had been removed that there was evidently pressure within the stump, and as the center of the flaps had not united, I cut the two middle sutures, the flaps separated and out popped (no other word will do) a pedicled growth, pear-shaped, as large as an egg (Fig. 1 shows it shrunk by hardening in alcohol). At



the first instant I thought of the biceps as having been held back by the Esmarch bandage, now hanging out by relaxation. Careful examination into the structures of the stump, the flaps having been retracted, showed them (the flaps) covered with granulations ready to unite. The bone presented a sharp clean cut ring on both edges of the cancellous portion, while from the center of the medullary cavity hung a pedicled tumor longer than the flaps, which was not covered by granulation, and which by its pressure was in effect a foreign body. This growth I ligated with catgut, intending the ligature to restrain blood loss, but the ligature drew through and I cauterized the base. The growth immediately recommenced, and in a week



FIG I

was again even with the flaps, but while in the first instance there was no disposition to union with the granulations of the flaps, in the new growth such disposition was marked, and finally union with the flaps resulted, the stump being in all requirements satisfactory. Causing the matter to be investigated the rare nature of the tumor appeared, and I concluded to draw your attention to the matter at length. In the plate accompanying this paper is a view of the tumor remaining four weeks in alcohol; there are also shown various microscopic fields. The histological investigation was made by Dr. Birchmore of Kansas City, and his report reads as follows :

"The growth when it came into my charge was rather more than one and one-eighth of an inch, and measured about three-fourths of an inch in its longest diameter. It was shrunken

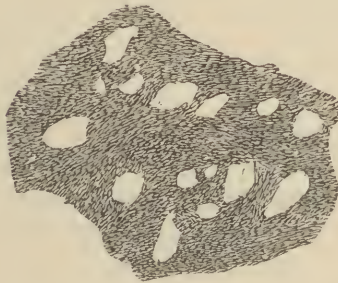


from repose in alcohol." On examination of the surface with hand magnifier it was evident that the covering surface was neither cicatricial tissue nor epithelium, and to the touch the growth was spongy and resilient, presenting the touch characteristic of the erectile tissues and locunated fibroids. On section one-eighth of an inch from the pedicle two zones ap-



X  $2\frac{1}{2}$   
FIG 2

peared, also a central portion. These zones, the outer one quite narrow and regular, seemed the projections of structures

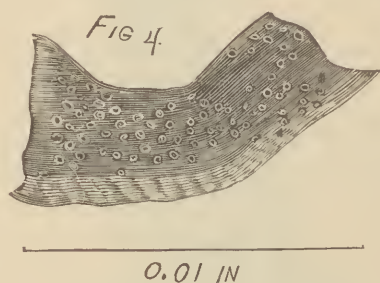


0.04 IN.  
FIG 3

covering the entire tumor. The thickness of this coat was not more than one-fiftieth of an inch. Immediately within the zonular projection just mentioned was another one of about three times this width, and the whole central portion presented

a pink tint, evidently from the number of red blood bodies engaged. The boundaries of these zones while *not* definite were sensible. Figure 1 shows the tumor as sketched while figure 2 shows the section above described.

Sections were cut by the paraffine-preparation method at an angle of forty-five degrees to the tumor face; the relations of these sections are shown in section 3. This shows the fibrous structure of the growth and the arrangement of the blood vessels, also the extra density of the marginal zone. In sections cut perpendicularly to the zone axis of the tumor it was evident that these belts were of more than descriptive importance and showed difference in structure which was quite marked.



Figures 4 and 5 are from the outer portion of the tumor. In this part of the growth the same peculiarities were presented as in the extreme margin. The condensation of the fibrillar substance and not so very numerous nucleated cells of not large size and small bioplasts without cell walls among the fibres, presented a picture too confused to be deciphered. In the vicinity of the blood vessel the same fibrillation becomes evident. From the disappearance of bioplasts one is disposed to consider the tissue as adult, as one which is simply a cicatrix. Figure 6 represents a portion of a field from near the centre of the section, at *a* appears the large lumen of a vessel presenting all the usual characteristics of a vastly increased capillary, the walls, however, seemed to be made of hardly

modified connective tissue, there being no true epithelium; *b*

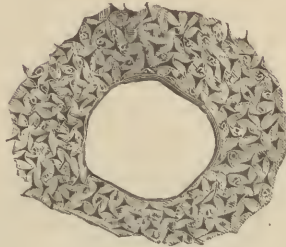
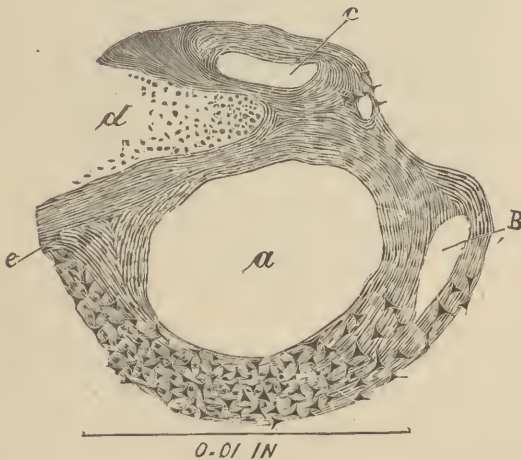


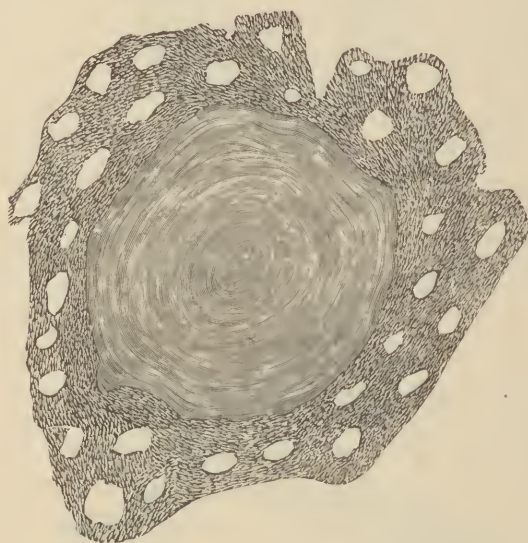
FIG 5

represents a small capillary communicating with *a*; on the other hand *c* represents all the characteristics of a blood vessel,



and is not undergoing changes into vacuoles or into erectile tissue; *e* shows a connective tissue band, part of a system uniting the whole structures in various parts; at *d* is a small collection of dead cells, these belonging either to the original blood clot or to the secondary effusion of lymph. To whichever they belonged inflammation has commenced in the sur-

rounding tissue. There are aggregations of pus cells in the various parts of the structure which have undergone caseation. The description of pus cells as granulation cells which have missed their vocation seems peculiarly applicable in this in-



0.04 IN  
FIG 7

stance. In a number of instances the relation shown in figure 8 obtains the tiny caseated mass forms a centre around which suppuration has commenced. At *a* is shown a lacuna like to the one marked *a* in figure 6, but unlike *a* in figure 6, it contains a fine net work of cells, some few usually central presenting nuclei staining red with carmine, at *c* is shown one of the much nucleated connective substance beams which on the side marked *d* shows an acute proliferation of the connective substance, forming a caseating nodule surrounded by acute suppuration. Part of the mass was displaced showing the connective tissue cells of the capsule at *d*."

Taking all the figured fields into consideration and a large number more showed me by Dr. Birchmore, I am inclined to think the history of the growth was automatically as follows :

"An organizable blood clot formed at the end of the bone, this underwent organization after the manner inferred in the classic description by Rhindflesh, and enlarged by interstitial growth. In portions retaining the conditions and characteristics of an organizable clot, in part undergoing change into fibroid tissues. The sketch marked shows the condition on the 19th or January.

The history from time of removal is as follows :

"After repeated cauterizations true granulations began to form on the growth in the centre of the stump, and by January

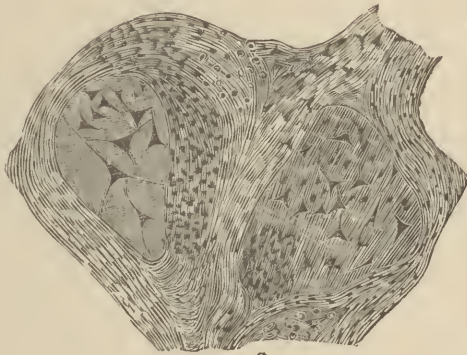


FIG 8

10th the edges of the bone lost their sharpness of contour, and finally a union was made between the central portion and the granulations of the flaps, the present face being one and a half or two inches from the face of the bone."

I trust I have not been wearisome, but the entirely unusual healing method seemed to me of interest, such a process not being classic, and while two or three growths after amputations have been described, in the upper arm not any.



## CHAPTER VIII.

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### HEMORRHAGE FROM RAILWAY INJURIES.

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In a majority of cases of railway injuries the hemorrhage will not be alarming, but the sight of blood is always appalling to the injured, and to those present as well. Not only is this true of the common observer, but surgeons, also, sometimes participate in this feeling of alarm. In contused and lacerated wounds the hemorrhage is not so extensive as in the incised wounds, consequently in injuries inflicted by the heavy machinery of the railway the bleeding is rarely alarming. We have known injuries where the entire lower extremity was crushed and torn, the muscles simply hanging in shreds, and the femoral artery severed, yet the patient was moved several miles to his home or a hospital with scarcely any loss of blood. In wounds of this character the arteries retract, and the shock to the nervous system is such that the heart is weakened to such an extent that the blood pressure is very slight, and the bleeding, therefore, not alarming. But when stimulants are administered and reaction is about to come on, then the hemorrhage may increase so as to endanger the life of the patient if prompt measures are not taken to arrest and control it. When the limb is crushed so as to demand amputation the operation should be performed at once and the vessels ligated. But when the injury is of such a nature that amputation is not required, or, if required, yet cannot be safely done at once, then the bleeding vessels should



be promptly ligated. In many wounds the first thing to be done is to arrest the bleeding, and to this end the surgeon must act promptly, divesting himself of all fear. As was said many years ago by Robert Liston, he must "learn to look boldly on the open mouths of the arteries." The surgeon should not become excited, or at least he must not manifest any special alarm, but be able to act promptly and energetically in arresting the hemorrhage.

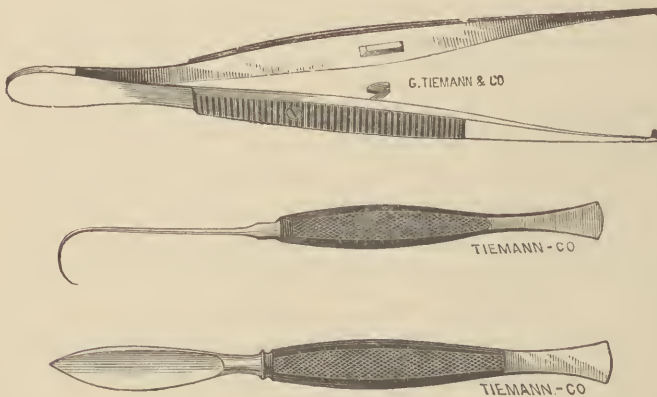
The application of an Esmarch bandage will most certainly control the bleeding until the patient can be moved to a convenient place where the vessel may be ligated. Do not attempt to permanently control the bleeding by compresses, bandages, or other temporizing appliances, as there is great danger of disastrous results. A few years ago the writer was called to see a young man who, ten days before, had received a flesh wound in the arm, severing the ulna artery. One of his companions, seeing that there was much bleeding, placed a quid of tobacco in the wound, applied a compress on it tightly and arrested the hemorrhage. When the surgeon arrived he removed the bandage, closed the wound with a few sutures, applied some styptic, and left the patient, who afterward became very sick. On the next day there was some more hemorrhage, and from that time on until he was visited by the author there was more or less bleeding each day. The surgeon who had the case in charge would, at each bleeding, apply some styptic and additional compresses, so that when we saw the case the arm was much swollen, and the patient exsanguinous. We opened the wound, removed the tobacco and ligated the vessel. The young man made a speedy recovery. This case is mentioned to illustrate the necessity of at once ligating important arteries when severed, and not attempt to control the bleeding by compression. Too many surgeons cannot "look boldly on the open mouths of arteries," but become alarmed. Especially is this true when they have not been carefully disciplined in the practice of surgery by a special training, and by availing themselves of the large experience of other surgeons. It is indeed impossible for the

surgeon to be too well acquainted with this important subject, or too well prepared to meet its varied and painful emergencies. We cannot envy that man his feelings who, through ignorance or inattention, will allow a patient to bleed to death when he might have saved his life.

It will not be required in this connection to speak of the different characteristics of arterial and venous blood. Every surgeon will readily recognize the arterial from the venous hemorrhage.

#### THE LIGATING OF ARTERIES.

This operation requires great skill and demands very accurate anatomical knowledge. The many beautiful diagrammatic illustrations and the most minute details in every step of



the operation cannot take the place necessary to be done in the dissecting room, and the operations made upon the cadaver. This is the training school for the surgeon, and unless he is thoroughly acquainted with the course of the artery and its anatomical relations, he never should undertake an operation so delicate. Agnew says: "In fine, his knowledge of special and topographical anatomy should be so thorough that at any moment he can reproduce a mental picture of each particular region before a single incision is made."

The instruments required for this operation are one or two scalpels, forceps, retracters, groove director, a tennaculum, aneurism needle, with catgut, silkworm gut, or silk ligatures, and in addition he should always have an Esmarch bandage. While it may not be necessary to force all the blood out of the limb when making the operation, yet it will be important to apply the bandage so that the steps of the operation may not be impeded by the flow of blood until the artery is reached, after which the elastic band can be loosened and the vessels will soon fill with blood, so that they can be easily recognized, and thereby avoid the danger of ligating the vein and artery together.

When an artery is wounded it should always, if possible, be ligated in the wound, and if it is necessary to enlarge the wound the surgeon should not hesitate to lay bare the vessel, even though he may be compelled to make a deep wound. When the artery is found, it should be carefully separated from the cellular sheath and ligated above and below the injured spot with carbolized catgut. After the ligatures have been applied it will be well to divide the artery between the two points so that both ends of the divided vessel may retract. After the vessel has been ligated, if bleeding still continues from the wound some other vessel must be injured. This may be from some small branch which is given off from the main artery. In such case the vessel must be sought for and ligated before the wound is closed.

In some cases of injury to an artery, a large vein may also be wounded, which will continue to bleed after the artery has been tied. This will be manifested by the flow of dark blood from the wound, which will be increased by pressure being made at a higher point. Bleeding from veins can generally be controlled by the use of a compress, but if it cannot the injured vein should be ligated. These operations are frequently difficult to make, but with the use of the Esmarch bandage they are more easily performed.

If in any case the direct ligation of the vessel cannot be made, the surgeon should cut down on the main trunk at the most convenient point and ligate in its continuity.

After ligating and the hemorrhage is arrested the wound should be treated antiseptically, and in some cases it will be proper to insert a drainage tube, but in a majority of cases this will not be required.

#### THE OPERATION OF LIGATING A DIVIDED ARTERY.

After exposing the vessel or its open mouth to view, it should be seized with suitable forceps. Liston's bulldog forceps, Spencer Wells' artery forceps, Prof. Wright's artery and



needle forceps are good instruments for this purpose. A tenaculum may be useful in drawing the vessel out from its bed and holding it while the surgeon separates all the surrounding structures. Special care should be observed that the accompanying nerve is detached. The ligature should then be placed around the vessel and drawn sufficiently tight to divide the inner and middle coats of the artery. Great care must be taken that the nerve is not included in the vessel, for the reason that it would cause great pain, sometimes tetanus and death.

The ligature having been drawn sufficiently tight should be secured by a surgeon's knot. Some surgeons prefer the reef knot, but the surgeon's knot is preferred by the author; and the objections made to it by surgeons, claiming not to be able to close the vessel, has never been realized in the author's practice, and it is believed to be more fanciful than real. In all cases of ligating bloodvessels the carbolized catgut can be used, but in large vessels it is believed to be the better prac-

tice to use the carbolized silk, for the reason that the animal ligature will give away too soon, and may be the cause of serious secondary hemorrhage; the silkworm gut is certainly to be preferred, and in larger vessels the silk is the more reliable.

The after treatment will be the same as that in other wounds. If the main trunk has been ligated the limb should be kept warm by the use of artificial heat, by first enveloping the limb in cotton wool and applying bottles of hot water around it. This should be continued until collateral circulation is fully established.

## CHAPTER IX.

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### EXCISION OF JOINTS AND BONES.

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Excision, which is also termed resection, may be made in the continuity or in the contiguity of bones; that is, between or through the articulation. In some cases of railway injury it becomes necessary to remove a portion of injured bone in compound fractures when the ends of the bones are projecting through the soft parts, and can not be reduced by the usual methods. Also in cases of compound dislocations where the reduction can not be easily made. In the former it is termed excision in continuity, and in the latter, in contiguity. In some cases where a fracture has not united after the ordinary means have been employed, it has been found to be good practice to excise the ends of the bones and bring them together, keeping them in apposition by the proper methods, and in this way secure complete union of the bone. In the hospitals of Europe, in many cases of vicous union after fractures, excision is made and the deformity corrected by this procedure. The railway surgeon will have many cases where the large joints are involved, where excision may be resorted to instead of, and preferable to, amputation. The author has had but a limited experience in this operation. In most cases of railway injury where the joints are involved, the surrounding tissues are so seriously contused and devitalized that it is impossible to save the limb, and amputation must be made. But in all cases of compound dislocation, where the tissues surrounding



the joints are healthy, it is good practice to excise the bones and save the limb.

Prof. Gross, in his *System of Surgery*, vol. i., p. 529, says: "In compound fractures and dislocations excision has been practiced almost from time immemorial, and frequently with the most satisfactory results. In the latter of these accidents in particular, whether involving the large or small articulations, experience has shown that it is generally more safe, both as it respects life and limb, to resect the ends of the protruded bones than to restore them in the usual manner. In the ordinary reduction the synovial membranes and cartilages are usually destroyed rapidly, profuse suppuration takes place and the patient gradually sinks under hectic irritation; or, if after having struggled through the general danger he escapes with his life he is very liable to lose his limb, or, at all events, to have a permanently stiff, deformed and useless joint."

The cases demanding excision, either in the continuity or contiguity of the bone, should be treated under the most careful antiseptic precautions, and it will not be necessary to again repeat these precautions, as they are the same in this operation as in amputation or any other surgical operation. The surgeon should have all his instruments prepared and know that he has everything at hand that could be required in any emergency; or, as Dr. Gross says: "it is always desirable to have rather too many than too few, so that every emergency may be promptly met as it arises." In making the excision through the skin the ordinary scalpel will be the best; in detaching the bones and ligaments a good strong cartilage knife with a metallic handle will be found necessary. A good chain saw (Fig. 184, Gross' *System of Surgery*, vol. i., p. 531) should always be at hand, and yet, when the end of the bone can be forced out through the soft parts so that the small blade of the Butchers saw (Fig. 181, Gross' *System of Surgery*, vol. i., p. 530) can be used, it is to be preferred. In some cases a small straight saw with a movable back will be found a most excellent instrument in this operation. A number of bone pliers, chisels, gouges, etc., should always be on hand.

## THE OPERATION.

After giving the anesthetic the elastic bandage should be applied so that the operation will not be interfered with by the flow of blood, which is always a serious obstacle. Some surgeons say that when the parts are greatly infiltrated with fluids, the bandage should not be used. This objection will not hold good in railway surgery when resection is required, for the reason that the soft parts have been so torn and lacerated that in most cases the blood and serum has constantly been escaping through the wound, and while there may be some swelling, the fluids in the cellular tissues will not injuriously affect the general system, even though it be forced up into other tissues, which the author does not believe takes place in the ordinary use of the elastic bandage. In compound comminuted fractures the removal of fragments must be through the wound, if this can be done without enlarging it, but if not, then an incision should be made so that the fragments can be withdrawn. In enlarging the wound nerves and blood-vessels should be avoided, and muscles and tendons should not be divided nor their attachments incised, but should always be separated with a blunt instrument. When a considerable portion of bone is to be removed the same precautions are to be observed in making the incision as in that of enlarging the wound for the removal of fragments of bone in cases of compound comminuted fractures. After the bone has been exposed the surgeon should endeavor to preserve as much of the periosteum as is possible for the purpose of the reproduction of the bone. The last method is to incise the periosteum the full length of the bone and then detach it with the periosteal knife.

After the periosteum has been removed the bone must be divided by cutting forceps or the saw, the latter being preferable in a majority of cases. In using the saw the soft parts must be carefully protected by compresses, or the slipping under the bone of a spatula. After the bone has been divided the wound should be carefully cleaned and every spicula of bone removed. In excision of the joints every portion of the

capular ligament should be removed, for experience teaches that when this precaution is not taken serious inflammation will follow. After the wound has been thoroughly cleaned the Es-march bandage should be removed and the wound carefully examined to see that no small arteries are bleeding. Should any be found they should be carefully ligated or twisted. After all bleeding has been arrested the edges of the wound are approximated and held together by the interrupted suture and dressed antiseptically. A calcified bone drainage tube will be of some value if placed in the wound before the edges are brought together. Before the patient is removed from the operating table the limb should be placed in the position in which it is to remain. This is done by the use of appliances, such as splints, plaster-of-Paris dressing, etc., so that the limb can be kept perfectly quiet. In the lower extremities it will be the object to secure osseous union, as the limb would not be of any use without it; consequently no passive motion should ever be made, but in the upper extremities this rule will not apply, as an ankylosed shoulder or wrist would not be of much service, and yet it is better than to sacrifice the entire limb. The dressing should be allowed to remain undisturbed for at least ten days, unless some favorable symptoms present themselves, when it should be removed under the antiseptic precautions. We shall not give the special operations on the different bones and joints, as they are found in most of the text-books on surgery.

## CHAPTER X.

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### CONCUSSION OF THE BRAIN.

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Surgical writers have variously defined concussion of the brain; hardly any two agreeing in regard to it. A general idea is that it is a commotion of the nerve fibres. Gross, in his "System of Surgery," says (vol. ii., p. 121):

"The most common idea appears to be that it is a commotion of the nervous fibres, or, more properly speaking, of the nervous tubes, inducing a change, vague and indefinable, in the relations which they sustain to each other and their vessels. How far such a view is worthy of adoption is not easy to determine; but it is very certain that, notwithstanding all that has been said upon the subject from the earliest periods of medicine down to the present, the progress of science has failed to afford any substantial light respecting the true mechanism of this occurrence."

Many writers object to the term concussion for the reason that the word is vague and indefinite. The same objection could be made with equal propriety against compression and many other terms which we employ to express injuries. In the sense in which the word is used, to express the cause of certain phenomena, no better term is suggested than that of concussion. The force may be either direct or indirect; any form of violence which results in a shock to the brain structure. Perhaps the most common cause is a direct blow, as when a person is struck upon the head, either with a club, or by an

overhead bridge or any other solid object, while standing on a rapidly moving train of cars. Falls are very common causes of concussion, and it is not always necessary that in falling the head should strike first, as the concussion may be transmitted when striking on the feet, but when the injury has been transmitted to the brain by the patient lighting on the feet, there is great danger of a fracture at the base of the skull. Prof. Gross says:

"Similar effects occur when a concussion is occasioned by violence applied indirectly, as when a person falling from a considerable height alights upon his feet, knees or buttocks. Here the force of the injury is transmitted along the bones of the extremities and of the spine to the base of the skull, where, exploding, it is communicated to the brain very much in the same manner as when the head is struck with a hard body, as a bludgeon, poker or brick. The effect of this form of concussion may be illustrated by what occurs in the boyish amusement of killing woodpeckers in countries abounding in cherries. To prevent the depredations of these marauders a slender pole is sunk in the earth, its head protruding at the top of the tree. When the bird alights the pole is struck with an ax and the vibratory motion thus transmitted through the pole to his body kills him in an instant. Now in this case death is caused, not by any change of bulk in the brain nor by any alteration in its consistents, but simply by the jarring of its substance, disqualifying it for the transmission of the vital fluid, and, consequently, also for the maintainance of its circulation."

then simply a shaking up of the brain substance. A jarring of the brain cells without serious lesion. Agnew, in his work on surgery, vol. i., p. 274, says: "There are four varieties of concussion. (1) Cerebral vibration without visible lesion. (2) Vibration followed by sero-sanguinolent transudation. (3) Vibration attended with extravasation. (4) Vibration accompanied with laceration of the brain substance."

In the first variety, cerebral vibration without visible lesion, there is simply a molecular disturbance of the cells composing



the brain substance. Cases have frequently been met with where train men have fallen from a moving train, and, lighting on the feet, knees, buttocks or head, would arise and stagger and sometimes fall again, but would almost instantly rise again and then sit down. For a short time the patient would be bewildered and confused; could not say anything about the accident, but would sit quietly and appear to be very much confused; could not collect his thoughts, and quite pale. In a short time a perspiration would break out upon the surface, the patient would yawn and perhaps complain of nausea, and would probably vomit. These symptoms will only continue for a short time when the patient will be able to arise and walk. It may be at first with a slight tremulousness of the limbs. His intelligence has been regained, and in a few hours he has entirely recovered from the injury. We are unable to give the precise pathological changes, if any, which take place in a case of this form of concussion, but there can be no doubt but that the change is in the cellular portion of the brain substance, and is simply a shaking up of the brain substance. Dr. Agnew illustrates: "A watch falls on the floor and at once ceases to record the time. It is taken to a watch maker, and after the closest scrutiny he fails to discover what has happened, but explains the condition as one of jar or strain." A sudden shake will sometimes put the mechanism again in motion. All of the symptoms named may be increased in severity, and the patient may appear to be dead. Persons have often been heard to say when present at the injury of others that when they first saw them they thought they were dead, but after moving them could see that they were breathing. The symptoms may be of short duration, yet the writer has had cases where they have continued for a number of days before any real change for the better came on. One encouraging symptom is vomiting. When this occurs, either early or later in the case, it is always to be regarded as a favorable symptom and it is certain that consciousness is returning. The pulse will now become fuller, less frequent and stronger, the color will return to the face and the unconsciousness will gradually pass away.



In the second variety, where the vibration is followed by the transudation of a sero-sanguinolent fluid, all the symptoms are more pronounced, it being almost impossible to arouse the patient, yet this can be done. The breathing may be quite noisy but not stertorous. The patient will assume a peculiar position in bed; his limbs will be flexed upon the abdomen and his head drawn forward. In this peculiar position he will remain for a long time, and if an effort is made to have him change his position, he will at once assume the same position again. Should the extravasation be on one side there will be a peculiar tremor of the limbs of the opposite side, or it may be on both sides. There is in these cases a transudation of a bloody serum through the blood vessels of the brain, and is the same as congestion in any other tissue or part of the body. There is but little difference between this variety and that where we have extravasation of blood, only in this it is termed contusion of the brain. In the variety of vibration followed by laceration the brain substance is torn and is usually associated with fracture of the bones of the skull. This is always to be regarded as a serious injury. There will be great restlessness, the patient tossing himself from one side of the bed to the other, not unfrequently moaning and sometimes screaming in a most frightful manner. The respiration is generally quiet, the pulse is slow, the pupils dilated and the temperature but little changed from the normal. While most authors claim that in all of these cases of concussion the pupils will be contracted, the experience of the author is that they vary much in some cases; one pupil will be dilated while the other is contracted. The most important symptom is that of semi-consciousness, showing that there is only concussion and not compression. This is an important diagnostic symptom.

*Prognosis.*—There is always a degree of uncertainty in every case of concussion, and the surgeon should be guarded in his prognosis for the reason that when reaction comes on and the patient vomits, with restored intelligence, a speedy recovery may be hoped for. But should there be much headache, with a clouded intellect, reaction not fully established, with a cold

surface, a feeble heart, the sphincters relaxed, the pulse irregular, with an increase of stupor, or if there should be a return of convulsive movements of the muscles, the case will be very unfavorable. The surgeon should not forget that vomiting is always a favorable symptom and indicates a return of the nervous sensibility, and when this symptom comes on, the surgeon can then have some hope of a favorable termination of the case. Yet the danger is not at all passed. In 1884 two young men were standing on the top of a car of a moving train, while it was passing under a bridge, and both were struck and knocked off the car. Fortunately the passing cars did not run over them, so that the only injuries they sustained were those of concussion with some scalp wounds, and in one case a fracture of the parietal bone, but no compression. In these cases the symptoms of disordered intellect continued for several weeks, but both made a good and complete recovery. After the symptoms of reaction came on, such as vomiting and a regular pulse, there was considerable fever and in one case some pain in the head, and at the period of ten days' symptoms of inflammation of the brain came on, but yielded readily to treatment. The surgeon must not think there is no more danger after reaction has come on, but must watch the case with great care and note every symptom, that he may be ready to meet the indications as they are presented. No permanent results follow concussion of the brain, except when the case is complicated with a fracture of the skull, or serious injury of the brain in the form of a laceration or contusion. In many cases of railway injuries, especially when there is a hope of securing some remuneration from the company, great pain will be complained of and many symptoms would indicate some permanent injury to the brain; but in many of these cases the writer has observed that as soon as the case was settled with the company the patient would entirely recover. There are cases of permanent injury to the brain, but in many of the cases where there is a suit for damages pending, implicit reliance cannot be placed upon the statements of the patient.

*Treatment.*—The indications in the treatment of concussion are to establish reaction and to prevent inflammation. In some cases where there has been but a slight concussion no special treatment is required, as the patient will in a short time recover. Only a few hours' rest and quiet for both mind and body is required. In cases where the concussion is more severe the patient should be kept in the recumbent position, with the head low, applying artificial heat to the extremities and spine, and supplying an abundance of fresh air. If deglutition is unimpaired, a little tea or coffee may be administered, but the writer cannot too strongly condemn the unfortunate yet common practice of administering brandy and whiskey before the arrival of the surgeon and frequently after he has taken charge of the case. If, after several hours have elapsed, the body continues cold and bathed in perspiration, with a feeble heart, some diffusible stimulant should be administered by the mouth if the patient can swallow, if not it should be given by enema, but should be given in small doses and at considerable intervals of time. It will require a long time for the absorbents to take up the liquid, consequently there should be sufficient time for the medicine to be appropriated before any other is administered. As soon as symptoms of reaction come on, a good brisk saline cathartic should be given. This is always beneficial. If reaction comes on and there are symptoms of inflammation counter-irritation may be made behind the ears or at the nape of the neck. Leeches applied behind the ears and at the temples will in many cases be of value. Quiet in the recumbent position is of the greatest importance. Absolute rest both of the mind and the body must be enjoined. All visitors must be excluded and the patient left alone with his nurse or attendant. The head should be elevated and covered with cloths wrung out of hot water, never cold, as the cold will cause a greater determination of blood to the head, while the hot will aid in the elimination of the heat and will subside the inflammatory action. The bowels should be thoroughly purged with an active cathartic: The room should be darkened but well-ventilated, and the diet should consist of

liquid such as milk, beef tea and toast. To relieve the pain and secure sleep decided doses of bromide of potash from 30 to 60 grains combined with 5 to 10 grains of hydrat chloral every three hours will generally bring about the desired result. Dr. Agnew says: "Opium when the bromide fails will often produce the happiest effect in calming the excitement and disposing to quiet sleep." Opium should be very cautiously administered in these cases, and yet I have found it very valuable in cases of traumatic inflammation of the brain, but should not be given in large doses, and when the desired effect has been produced, that of securing sleep, should be discontinued. After the acute symptoms disappear, the nourishment should be increased, and should the patient exhibit signs of exhaustion some stimulant should be administered. The patient must not be allowed to leave his room or bed for more than two weeks. It is not safe to allow a patient to sit up for at least ten days or two weeks after his attack. If the patient becomes much reduced tonics should be carefully administered and in such cases good nourishment, with iron and rest are absolutely indispensable.

## CHAPTER XI.

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### COMPRESSION OF THE BRAIN.

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The question is often asked whether the brain can be compressed. That is, whether the brain structure can be more closely compressed by external or internal force than when in its normal condition. There can be no reason why such compression is not possible, and I believe that it is frequently the result of injury, either by external or internal force, although the peculiar pathological condition may not be fully understood and may not be of any practical importance. Jonathan Hutchinson says :

“Compression of the brain from depressed fragments of bone is an imaginary condition.”

To this statement we cannot assent. While the term compression of the brain may be open to many objections, yet it expresses just what is understood by the true condition of the brain substance. Agnew says : “Where the word is used as a conventional phrase, there can be no confusion or misunderstanding resulting from its retention in the surgical nomenclature of cranial injuries.” Compression of the brain may result from different causes, the most common being depressed bone, extravasation of blood, foreign bodies introduced from without and inflammatory products.

*Symptoms.*—The symptoms of compression are those of complete paralysis of all the muscles. The patient is dead to the external world, insensible and unconscious, no words are



uttered, if spoken to makes no reply, will not answer any questions, not even in a monosyllable, neither does he hear or see, taste or smell; all the special senses are destroyed or arrested for the time being. The urine is passed involuntarily or retained until the bladder becomes enormously distended; the pupil of the eye is fixed, either dilated or contracted, or one may be dilated and the other contracted. The breathing is noisy, sterterous and puffing, which is due to the paralysis of the muscles of the mouth, throat and face. The heart beats slower and the pulse will be found to be irregular, and sometimes not more than 40 beats per minute, in consequence of which the temperature will be found to be below normal. Typical cases of concussion and compression possess well-marked and characteristic distinctions which have been contrasted by Dr. Agnew as follows :

CONCUSSION.	COMPRESSION.
Unconsciousness incomplete. Patient can be made to answer though it may be briefly and in single words.	Complete unconsciousness; may scream into patient's ear at the top of the voice but will receive no answer.
Special senses though greatly blunted are not abolished.	Special senses entirely suspended.
Power of movement not destroyed. If the position of a limb be changed the patient will resist or bring it immediately into the original position.	Complete or partial paralysis; in most cases hemiplegia.
Respiration is quiet and feeble.	Respiration is full and noisy.
Pulse feeble, frequent and intermittent.	Pulse full and slow.
The stomach sickens and rejects its contents.	The stomach is insensible to any impression; no nausea or vomiting.
The fæces may be discharged incontinently, as may also the urine.	Bowels are torpid and the bladder incapable of emptying itself, though the urine may escape by overflow.
Deglutition not destroyed.	Deglutition impossible.
Pupils variable, though generally contracted; the eyelids somewhat open.	Pupils variable, though generally much dilated and the eyelids closed.
Temperature of the body less than natural.	Temperature almost natural, a little below the natural standard.



These well marked symptoms are not found in every case, and every surgeon will find cases where there will be a great variation from these sharp, well defined, differential distinctions. A case which came under personal observation in 1875 at the Cincinnati Hospital is one in point. A laborer was struck on the head by a piece of timber, causing a fracture of the bone. He walked to the hospital, gave his name and residence correctly, and related the circumstances of the accident causing the injury, but was somewhat bewildered in his mind, and had all the symptoms of concussion, but in a few hours all the symptoms of compression came on. Dr. Mussey trephined, but the patient died in less than twenty-four hours after receiving the injury. In the author's practice of railway injuries, quite a number of cases have been treated where the symptoms and the points of differential diagnosis were not as well marked as appears in the above table. If compression of the brain were always an uncomplicated affection, then it would be quite easy to make a correct and certain diagnosis, but such is not the case, as the symptoms of concussion and compression are in many cases blended, so as to render it doubtful to which they belong.

A few cases have been met with where the symptoms were those of compression and in a short time would become those of concussion, and vice versa. But notwithstanding these irregularities the main symptoms of distinction, as given above, hold good, and are of great practical value. Compression from extravasation of blood is of frequent occurrence, and may exist either with or without a fracture of the skull, and is mostly the result of violence which acts upon the blood vessels of the brain and its covering. When the brain is compressed from the rupture of a blood vessel, the symptoms do not come on so suddenly as they do when the compression is caused by the depression of bone, in which case they are immediate. The symptoms may be preceded by those of concussion, but are soon followed by those of compression. When a person is injured by falling from a moving train, his head striking the ground, or upon some hard substance, or by being

struck by an overhead bridge, or in any other way receiving a blow upon the head, causing a fracture of the skull, and driving the fragments in upon the brain, which results almost immediately in general insensibility, paralysis, stertorous breathing, slow pulse, with dilated pupils, the surgeon may be almost certain that the case is one of compression from depressed bone. In other cases where the injury is similar to those above described, there are symptoms of concussion followed in a few hours, or even a longer period, by those of compression, the cause in all probability is that of extravasation, the hæmorrhage having been slight, the oozing being continued, accumulated after a time in sufficient quantities to compress the brain. When symptoms of compression set in at some period between the 6th and 30th day, after an injury to the skull, the cause may generally be considered that of purulent extravasation, or of an abscess. Cases have been met in personal practice where, after an injury to the head, the patient would apparently recover, and be able to attend to his labor or business for a number of years, when symptoms of disease of the brain would manifest themselves and finally result in serious mental disturbance, and after a time prove fatal. A case which illustrates this in a remarkable manner is presented. During the war a soldier was struck in the forehead by a ball just between the eyes. He fell, but soon arose and resumed his place in the company. After continuing on duty for nearly a year he was mustered out of service at the close of the war. The surgeons regarded the wound as one made by a spent ball, and did not think that it had penetrated the skull. Nine years after the injury was received he began to complain of muscular pain in his limbs, and in a short time became insane, and in about one year after these symptoms manifested themselves he died. A post-mortem was held, and a minnie ball was found located just between the optic nerves, surrounded by about one drachm of pus. Dr. R. Harvey Reed, of Mansfield, Ohio, in an able paper on Clinical Observations on Some of the Effects of Direct and Indirect Traumatizations of the Brain, read at the meeting of the National As-

sociation of Railway Surgeons at St. Louis, Mo., May 2 and 3, 1889, in closing his paper, made the following observations:

"1. That very slight injuries to the cranium may produce such an amount of cerebral irritation as to cause a fatal termination years after the traumatism is received.

"2. That the brain, under certain circumstances, is capable of making a rapid recovery from a severe injury of the calvaria producing a continuous mechanical pressure on some portion of the encephalon, from which it will probably rally, and for the time being assume its normal functions and maintain them for years before it succumbs to the effects of the traumatism.

"3. That we may have grave destruction of portions of the motor and sensory nerves without either anesthesia, hyperesthesia or motor paralysis.

"4. That an injury and escape of portions of the brain substance is not necessarily immediately followed by motor or sensory paralysis, or even loss of consciousness, although it may follow weeks subsequently.

"5. That abscess of the brain, or traumatic cerebritis accompanied with fungus cerebri, may each be followed with aphasia and motor and sensory paralysis.

"6. That an apoplectic cyst may undergo calcareous degeneration, and thereby develop a mechanical irritation which will sooner or later prove fatal.

"7. That an embolus may cut off the blood supply of a certain arterial territory, and so devitalize that portion of the brain as to become a *locus minoris resistentiæ* for subsequent infection with pus microbes.

"8. That grave injuries to the brain are liable to be followed with such a degree of devitalization of the economy as to favor general tubercular degeneration.

"9. That the presence of indican in the urine is synchronous with cerebral degeneration.

"10. That whilst there may be nerve cells capable of taking on definite functions under certain circumstances distributed here and there throughout different portions of the encephalon,

yet clinical experience points to the bilateral centralization of certain nerve cells at certain definite points, the injury of which produces fairly definite and reliable results.

"11. That all mechanical irritation of the brain substance, no matter how slight or how grave, should, when at all practicable, be relieved by surgical interference at the earliest possible date, and that the refusal to give our patients this chance for their lives is not only criminal but barbarous neglect."

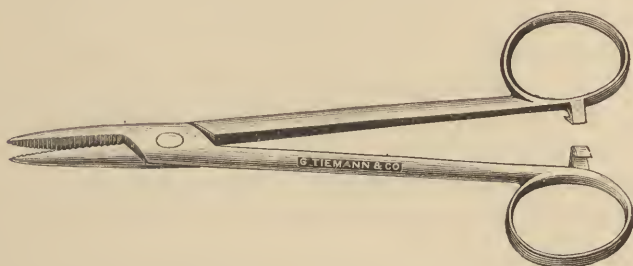
#### TREATMENT OF COMPRESSION OF THE BRAIN.

When the compression is in consequence of depressed bone the indications for treatment are to cut down and elevate the depressed bone. In making this operation the patient should be placed on an operating table with the head slightly elevated, by placing a pillow under the head and shoulders. The scalp should be carefully shaved and cleansed with soap and water and the use of the flesh brush, and afterward cleansed by the bichloride solution. In this as in all operations the necessary antiseptic precautions are to be strictly observed. After the parts have been thoroughly cleansed the bone should be freely exposed by a suitable incision. In many cases the bone will



be found denuded so that not a very extensive incision will be required. The removal of any portion of the scalp is not recommended unless it be completely devitalized. Prof. Gross says: "In no event should any portion of the scalp, however severely contused or lacerated, be cut away." Should there be much bleeding after making the incision the vessels should be grasped by a Spencer Wells artery forceps. The bleeding usually ceases in a short time of its own accord. The periosteum should be carefully dealt with as the success of the operation and the future healing of the wound will greatly depend on this precaution. There should be no scraping of the bone,

an occurrence which greatly retards the healing of the wound and may result in exfoliation of the bone. The instruments



required for this operation are a trephine, a pair of good forceps, a trephine brush and, as is usually recommended, a Heys



saw, but the author has never found any other use for this instrument than to fill up his instrument case. I have found



the lenticular of more value and prefer it for the purpose of elevating the bones and smoothing up the cut surfaces of the



bone. In the hands of a young operator the conical form of the trephine is to be preferred to that of the ordinary trephine.

There is, however, an objection made to the conical by some



surgeons for the reason that from the uneven division of the outer and inner portions of the skull necrosis is said to be more liable to occur, but the writer has never had any such results following its use. Certainly this form of instrument is much safer as it is almost impossible to injure the brain. The instruments should be placed in a 5% solution of carbolic acid and the sponges in the bichloride solution. After the incision has been made and the bleeding has ceased the trephine, with its center pin protruding and securely fixed in its position, should now be applied to the bone which is to be removed. The instrument should be carefully worked with a quick movement and a steady even pressure. As soon as a sufficient groove has been made to steady the instrument the center pin must be withdrawn and again firmly fixed, so that there may be no danger of it injuring the brain or duramater. The surgeon will then keep up the even pressure and quick movements of the trephine and after the outer plate is cut



through he will remove the instrument and with the trephine brush remove all the bone dust both from the groove and instrument, immersing the trephine in the solution of carbolic acid. This procedure should not be neglected, and the groove should be carefully examined with a probe to ascertain the depth, and to see whether the cut is being made evenly. In some cases the bone is of unequal thickness at different points of the circumference of the trephine, so that while the bone may be cut through at some points, it is firmly held by some portion of the inner table. When this is found to be the condition the point should be carefully sought and then make easy and careful movements of the trephine, so as to avoid the tearing of the duramater. The looseness of the disk is easily ascertained by making a slight rocking movement of the trephine. The disk is easily removed by taking hold of it



with a pair of forceps or tilting it over with the elevator. After the removal of the disk where there is depression of bone the elevator can be applied and the depressed bone replaced. In a few cases some difficulty has been experienced in elevating the depressed portion even after the disk has been removed, but in the majority of cases no difficulty will be experienced in the matter.

In operating for blood or pus a large trephine should be used. It has been suggested that at the very outset of suppurative osteomyelitis a disk of the outer table of the skull should be removed with the trephine so as to give vent to the unhealthy pus. This may be good practice, but it would certainly be better to cut through both tables, as there is not so much danger of the pus forming between the inner and outer tables if there is free vent to the escape of all unhealthy material, and under antiseptic precautions there can be no danger in cutting through the entire bone. After the hemorrhage is controlled the wound should be freely washed out with the bichloride solution, and then the flaps brought together and united by sutures. It may be well to provide for drainage by placing in the wound a small drainage tube then complete the dressing by placing over the wound small layers of iodoform or carbolized gauze, which can be retained by a good bandage. Unless there should be much discharge of blood and serum, the dressing should not be removed for several days, and in some cases not for a week or ten days. We need not fear the accumulation of pus, as was the case under the old method of operating and dressing of a wound; but should there be any symptoms of this the dressing should be removed and the wound opened so that the pus could escape. The use of the ice bag and other cold applications in these cases must be condemned, as they certainly cannot do good, but must do harm. Should inflammation supervene, the application of warm fomentations is recommended, but this is not likely to follow where the necessary precautions have been observed in the operation and in the dressing of the wound. The patient should be kept in a well ventilated room, with perfect quiet,

no visitors admitted, and not allowed to engage in any excited conversation. The diet should be nutritious, but not stimulating, and the bowels should be kept open by the use of mild laxatives. One special feature observed in cases of injury to the brain requiring trephining is the retention of the urine, and in most of the cases met with in experience, the patient had to be catheterized for several days. The surgeon should always make special inquiry in regard to this point, for cases have been met with where no urine had been voided for more than 30 hours, and where the bladder was greatly distended and the urine partially decomposed. In making this operation, either for depression of bone, extravasation of blood, or the opening of an abscess, care should be taken not to apply the trephine over the course of the sutures. In some cases this cannot be avoided, but when it is possible it should be so done. I have considered the topics which will interest railway surgeons and will not speak of the use of the trephine for the cure of epilepsy, insanity and tumors, as this will be found in all of the regular text-books on surgery.

## CHAPTER XII.

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### BURNS AND SCALDS.

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The railway surgeon will be frequently called to treat cases of burns and scalds, as these accidents are of common occurrence among the men employed in the shops and on the engines. Burns and scalds differ only in this, that the one is the result of dry heat, and the other of moist heat, but practically there is no difference. Both are the result of a high degree of heat applied to the body. The cases most frequently met with in railway practice are those of scalds. Dr. Agnew says: "When the caloric is communicated from a solid body, as a piece of metal, it is called a burn, and when by a liquid or a vapor, as molten metal, boiling water, boiling oil, or steam, it is termed a scald." The former of these are deeper and more circumscribed than the latter. No attempt will be made to give the classification as detailed by Depuytren, as the railroad surgeon will have to treat cases in the shop, and frequently on the line of the road where men and passengers are injured by steam escaping from the engine, or the burning of cars when wrecked, and ignited from the stoves or lamps, so that the treatment must be prompt, and cannot always be applied in as satisfactory a manner as the surgeon would like to do if under other circumstances. A few years ago an unfortunate man was cleaning an engine in the round house of the Pennsylvania Company in the city of Fort Wayne, when the mud pan blew out and the hot steam covered him so that he was fearfully

scalded. When the writer reached him it was found that his fellow laborers had covered him with white lead paint, and he was comparatively comfortable. He was removed to his home and the surface covered over with absorbent cotton, saturated with carbolized linseed oil and lime water. Morphia sulph. and some spts. amonia ar. with brandy was administered internally. The patient did well and the dressings were not removed for ten days, but every six hours the absorbent cotton was saturated with the carbolized oil. When the dressing was removed it was found that the entire surface was healed. The history of this case is given to show that the treatment in similar cases is to cover the surface over with some substance which will not permit the atmosphere to come in contact with the affected surface, and that the antiseptic precautions are especially valuable in the treatment of these cases. A good application in burns and scalds is the following:

R	Cocaine muriate,	-	-	-	-	gr. iv.
	Ol. linseed,	-	-	-	-	ʒiij.
	Acid carbolic,	-	-	-	-	ʒij.
	Aqua calcis, q. s. ad.,	-	-	-	-	ʒvj.

M.

Sig. Apply with absorbent cotton and cover over the entire surface affected, and do not remove the primary dressing unless there is evidence of ulceration or the formation of pus, when the dressing should be carefully removed, the parts cleaned and the dressing reapplied. Dr. Neal Hardy, Professor of Physiology in the Fort Wayne College of Medicine, and surgeon of the Pennsylvania Company, published an able paper on burns and scalds in the May number of the *Journal of the National Association of Railway Surgeons*, from which we make the following extracts:

"Burns contiguous to thoracic, abdominal and pelvic viscera and involving extensive plexuses of the sympathetic system are extremely dangerous and often cause intestinal ulceration. Recovery from burns and scalds, exceeding one-third the surface of the body, is very improbable. Coma, followed by congestion of the brain, is a frequent and grave sequel. Erysipe-

las and traumatic fever are occasionally formidable concomitants, and in anticipation of which efficient prophylactic measures should be early instituted. Death usually occurs from shock, exhaustion, pulmonary complications and septicemic poisoning. Extensive and unsightly scars sometimes remain after cicatricial contraction, and the effort made at restoration or improvement is often disappointing.

#### TREATMENT.

Should the burn or scald affect the cuticle only, the area be quite limited, and the patient possess considerable resisting power, with but slight evidence of constitutional disturbance, all that will be required is anodynes to allay the pain and the surface thoroughly cleansed antiseptically, all blebs punctured, allowing cuticle to remain undisturbed, the parts well covered with absorbent cotton, English lint, or charpiel previously saturated in a solution of bi-chloride,  $\frac{1}{5000}$  or  $\frac{1}{10000}$ , or carbolized olive or linseed oil 3ij to 3iij, then covered with iodoform or carbolized gauze and finally with macintosh or oiled silk or a nicely adapted roller bandage. If suppuration does not occur, which evidenced by odor, the dressing should remain unmolested for eight or ten days, when reparation will probably be completed. If suppuration be discovered the wound should be rendered aseptic, then covered with iodoform and oaten flour, 1 to 10, applied with an insufflator or lint spread with cocaine, [1] bism. subnit. [2] lanolini [20] or salol [2] lime water [7] olive oil [7] or iodoform [1] vasaline [20] covered with carbolic or iodoform gauze and oiled silk, and kept in place by a few turns of a roller bandage. Iodoform and cornstarch, 1 to 20, thoroughly incorporated in a mortar is a very convenient and beneficial application. In extensive burns, penetrating the tissue deeply and accompanied with great agony, a subcutaneous injection of morphia and atropia should be administered first, followed immediately with inhalations of chloroform or ether and that prior to the removal of clothing or making an examination as to the extent of the injury. This allays fright, alle-

viates pain, diminishes shock, and hastens reaction. When fully under the influence of anodynes and anesthetics the surface can then be exposed, the extent of the injury thoroughly and painlessly investigated, amputations or other operations as well as proper applications to the surface be made, and that while the nerves are yet insensible to pain. Anodynes should be continued and if great depression manifest itself stimulants should be freely and frequently administered, also warm drinks and hot bottles, wrapt in flannel, should be placed along the extremities that blood may be invited to them and away from the viscera and organs most liable to congestion and inflammation.

Nervousness may be controlled by valerinate ammo. or bromide potassium; sleeplessness by sulfonal or morphia and atropia. Solution of carbolic acid [1 to 50] is a valuable application, when the injury is not too extensive, being antiseptic, also deadening the sensibility of the nerves. Linen, medicated cotton or prepared lint may be soaked in it and applied under oiled silk, so that evaporation can not take place nor the dressings become dry and adherent. Lint well covered with vaseline and iodoform, vaseline and eucalyptus, or lanolin and balsam Peru, to which may be added a small quantity of morphine, and over this a liberal supply of absorbent cotton well bandaged.

Boracic acid has proven valuable in deep wounds and may either be applied in a dry state, filling the cavity completely, or it may be used in solution covered with oiled silk. I have experienced gratifying results in scalds and superficial burns by surrounding the parts with absorbent cotton, then saturating it with linseed oil, covering it with a roller and finally enclosing all with a thick coating of white paint, thus forming a firm and impervious casing. It also serves the purpose of a splint, so necessary in giving the parts rest and in preventing cicatricial contraction, distortion and deformity.

During the healing process it is well to keep the integument on the stretch in order to counteract the contractile inclination. This may be accomplished best by the aid of splints.



Division of cicatricial bands is unavailing unless a position to oppose the contracting force be rigidly and perseveringly maintained during subsequent granulation. Massage and frequent flexion and extension of limbs is quite beneficial. Eucalyptus and vaseline spread on lint and placed between fingers and toes will prevent webbing.

Gangrenous extremities should be thoroughly cleansed with 1 to 20 carbolic solution and the limb enveloped liberally with carbolized cotton, over which is applied uniformly a roller bandage, thus equalizing pressure, supplying heat and often limiting the slough.

So long as the discharge does not penetrate the dressing or the gangrene extend above it and the wound remain free from odor the application should remain undisturbed.

Frequently amputation is the only alternative and should be made as soon as a distinct line of demarcation is established. Delay until separation of integumental structure is effected, is unnecessary and by it pain and emaciation is greatly increased and more danger from septicemic poisoning incurred.

If suffocation from laryngeal contraction, or edema of the glottis threaten, tracheotomy, or laryngotomy, should be performed.

Skin grafting and transplantation are occasionally very advantageously employed in accelerating reparation and in improving general appearances."

## CHAPTER XIII.

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### COLOR BLINDNESS.

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This has become a very important subject in railway surgery and especially among the officers who have in charge the employment of men to run the trains. Some States have passed laws requiring that the train men shall all be examined as to their perception of vision in regard to colors; and this has been done in some cases by men who are not physicians. No doubt in many cases the tests have been correctly made but it is believed that it would be more satisfactory if the tests and examinations were made by good competent physicians.

The earliest account of this ocular peculiarity is given by John Dalton, a celebrated English chemist and scientist. He was himself color-blind, and, hence, this defect of vision is sometimes called Daltonism. October 31, 1794, before the "Manchester Literary Philosophical Society" he read a paper entitled, "Extraordinary Facts Relating to the Vision of Colors." In that paper he refers to his own case and relates that, when a boy, he was present at a review of troops. Upon hearing his comrades remark of the beauty and splendor of the military costumes he asked in what respect they differed in color from the grass on which they trod? It was the deluge of derisive laughter and contemptuous remarks of his fellows in response to his inquiry that first made him aware of his defective eyesight.

Besides the blue and the purple of the spectrum he was able to realize but one color—yellow. Quoting his own words: “That part of the image which others call red appears to me little more than a shade or a defect of light.

After that, the orange, yellow and green seem one color, which descends pretty uniformly from an intense to a rare yellow.” No mention has been made in any ancient work earlier than the time named, 1794, and yet no doubt this ocular defect existed in all ages, and among all classes, just as it does now. The subject is one of great interest to the railroad surgeon as the probabilities are that many of the States will legislate requiring that engine men will have to be examined by competent surgeons as to their perceptions of color—compelling railroad companies to employ only such as hold a certificate of perfect vision. We shall not enter into a lengthy discussion of the many theories of this subject, but will give a few statistics and the best method of making the test.

The theory of color perception now generally accepted, was first presented by Thomas Young, an English physician, about the year 1802, and most ably defended by Dr. Holtz, a German physician and surgeon, in 1867. Their theory is based on the assumption that three distinct kinds of nerve fibres exist in the retina of the eye, the excitation of which gives, respectively, red, green and violet—fundamental sensations of color. Homogeneous light excites all three, but with different intensities. Just in proportion as these sets of nerve fibres are capable of excitation, just in that proportion will the color-perception be accurate and reliable.

If the fibres naturally susceptible to excitation of red be wholly paralyzed, or undeveloped, then the complimentary color will take the field, and complimentary shades as well. Thus white becomes bluish green, and so on through the entire catalogue of complimentary colors incident to red. Thus it was that Dalton could not distinguish between the red coats of the British soldiers and the color of the grass. The rods and cones in the retina receiving the waves of light and carrying them to the fibre of the optic nerve, designed to receive

the impression, was the same as the grass, which he could appreciate, as the nerve fibres for green were normal.

By far the more common defect in color-perception is insensibility to red and its compounds. But I have said more than I intended on this point. We should, however, have stated that in some cases we find total color-blindness, while in others we find only a diminished perception of color.

The question, which interests us more than theory, is this: What proportion of the community is found to be subjects of this defect? More males are affected than females; in fact, the latter are singularly free from the affection or defection.

The majority of observers find but little, or only slight, variations in males as to the per cent of the affected arising from race, social status, employment, business, etc. Most find over 3%, and few reach 5%. Dr. David D. Beck, in an able paper on this subject, read before the meeting of the Alumni of the Medical College of Ohio, made the statement; "That a general average of tens of thousands of examinations that have been recorded will show but 4%; in other words, about one man in twenty-five is color-blind to a greater or less degree. As regards females, the examinations show about one-fourth of 1%; that is, one in every four hundred or five hundred—at any rate a very small proportion."

Now, how does this proportion—and that is the essential point—hold good among railroad men and pilots? We find the per cent to be practically the same. Holmgren found among nearly 8,000 men  $2\frac{1}{6}\%$  color-blind. Fontenay, of Copenhagen, found among 2,700 railroad employes, 3%. Dundus found among 2,300 railroad men in Holland,  $6\frac{1}{2}\%$ . Krohn, of Finland, found among 1,200, 5%. Two thousand employes of the Pennsylvania Central,  $4\frac{1}{8}\%$ .

Now, since the flags and lanterns used by all the railroads are white, red, green, etc., and as this is the most common form of color-blindness, we need nothing further to portray the danger to life and property. In our judgement, however, it very rarely occurs that a man is so deficient in this regard as to entirely incapacitate him for railway service, inasmuch

as the slightest variation in shade would give him a foundation on which to establish a judgement as to the signal employed.

To illustrate: A. is a color-blind engineer. He may not be able to say this flag is red and this one is green; but he does recognize a difference in shade, as we would note a difference in yellow and orange; and by education he is able to judge as between them. They may both appear green to his eye; but there are two shades and he knows that the one shade signifies danger and the other safety.

This fact has been established in the case of a color-blind engineer on one of the leading railroads in this country. For 36 years he had been in active service. He could not tell anything about red and green, as such, yet he had made a most excellent record of service. He saw the two shades of green (that is, all colors were green to him like grass), and these two shades served his purpose just as well as the full realization of red and green would have done. No doubt this man became acquainted with these shades while employed as fireman, and by the time he was sufficiently skilled in the management of the machinery of the engine to be able to manage it on the road, he had also educated his eye sufficiently to detect the different shades of the signals.

We would not be understood to advocate the employment of men as either firemen, conductors or engineers on our railroads who have not perfect color-perception, and give it as our opinion that all railroad companies should have a careful examination made as to color-perception of all who come seeking employment; and it would be well to have some one appointed who should examine all applicants for positions, and that his certificate should be required before any one could be employed. "While the color-blind acquire remarkable skill in detecting variations in shade or in intensity of light, as light from a red lantern is less intense than that from a green one, and this again is less intense than that from a white one," hence the exquisite discriminating sense in this regard covers their defect. Again, a good, vigilant fireman may assist, and in fact may control, the engineer in this regard; but



occasions may arise with variations in the power of the light, or color of the glass, dust, steam or fog, when this skill on the part of the color-blind would prove inadequate, and disastrous results follow. We would suggest less stringent rules for those already in the service than for those who desire to enter it. There is no relief for it either by education or medicine, as in most of the cases it is congenital and incurable. The best safeguard is to remove all who are at important posts, and to not admit any who have any defect in color-perception.

The best method of testing is that by Prof. Holmgren the matching of colored wools with a test skein, which is so simple, so perfect and applicable to the desired purpose, as to render its use imperative and its success a matter of necessity. Quoting his own language, he says: "Our method demands neither costly apparatus nor a special place for examination. The only necessary elements are a number of variously-colored objects. It consists in taking from a number of objects promiscuously thrown together and asking the person examined to select from amongst them all the other corresponding with the first color. With regard to the colored objects it, of course, matters little in principle what their nature is, as in the main the method never changes, no matter what the kind selected. But, practically, the choice is by no means a matter of indifference. Among the ordinary objects suggested, and also used for the purpose, are pieces of colored glass or silk, or Berlin worsted, etc., the last of which seems to be the best, for the following reasons: One of the chief advantages of Berlin worsted is that it can be procured in all possible colors corresponding to those of the spectrum, and each in all its shades from the darkest to the lightest. Such selections may be found in trade, and are easily procured when and where desired. It can be used at once, and without any preparation for the examination, just as delivered from the factory. Berlin worsted is equally colored, not only on one or two sides, but on all, and is easily detected in a large pile, even though there be but one thread of it. Berlin



worsted is not too strongly glaring, and is moreover, soft and manageable, and can be handled, packed and transported as desired without damage, and is conveniently ready for use whenever needed." Other material may be employed, such as colored paper or silk, or colored glass, wafers, colored solutions, spools of colored thread, pieces of painted wood, etc. They can all be employed; but none of these objects are as well suited to our purpose as the Berlin worsted.

A selection is then made, including red, orange, yellow, yellow-green, pure green, blue-green, blue, violet, purple, pink, brown, gray—several shades of each color, and at least five gradations of each tint, from the deepest to the lightest. The examiner selects from the collection of Berlin worsted in a pile on a convenient table and lays aside a skein of the special color desired for this examination; then he requires the one examined to select the other skeins most closely resembling the color of the sample, and to place them by its side. The color-perception of the individual is decided by the manner in which he performs his task.

The result of the comparison which the examined makes, in other words, the little skein of worsted which he selects and places by the test, shows us in reality what colors seem alike to him, and thus tells us his relative color-perception. We could prolong, in detail, the test as to the arranging of the skeins, etc., but we only desire to present to the surgeons the best recognized method for testing for this chromatic defect.

Now, with this knowledge of the facts, this appreciation of danger and the certain method of detecting it, what course should surgeons representing great corporations pursue in this matter? The duty is a plain one. In every instance where an employe, afflicted with color-blindness, is discovered, he should be reported to the proper authorities, in order that he may not be charged with duties whereby the safety of the public and the interests of the company may be endangered through his infirmity. .

The question is sometimes asked of the surgeons, "what can be done for this ocular defect?" The truthful answer must be

"Nothing." It is beyond the reach of medical or surgical skill, and he who professes to be able to remedy it is a charlatan, unworthy the respect of his professional brethren.

The following is description of a series of Tests for the Detection and Determination of Sub-Normal Color-Perception (Color-Blindness), designed for use in Railway Service. By Charles A. Oliver, M. D., of Philadelphia.

"As it is a well-known fact, both from theoretical and practical standpoints, that many "Color-Blinds," especially those of medium grades, have the power of differentiation, even by daylight, of the most difficult colors, when placed at the ordinary one-metre distance of wool selection employed in the detection and determination of "Color-Blindness," the writer has been induced, through a hope to overcome the dangers that might arise from this power in situations, such as railway, marine, and naval service, where the safety of lives and the protection of property is oftentimes almost solely dependent upon proper recognition of color at great distances and frequently through the intervention of more or less translucent media, to combine two modifications of his method of color selection to a simplified plan of the former procedure by which the candidate is placed in the actual position of after-work and under exactly similar circumstances as during employment.

"To effect this purpose in railway service, the method is divided into three parts.

"First: The selection and registry of a definite number of loose wools from twenty-three pure and confusion match-skeins, thrown upon a dead-black surface at one-metre distance.

"Second: The selection and registry of the same number of similar reflected colors under various intensities of diffuse daylight stimulus, placed at distances requisite for safety.

"Third: The selection and registry of transmitted color under various intensities of artificial light-stimulus, placed at distances requisite for safety.

# COLOR BLINDNESS.

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## BLANK FOR THE REGISTRY OF THE COLOR-SENSE.

.....*Railway Company,*  
.....*Division.* .....*Station.*  
*Name,*..... *Age,*..... *Address,*.....  
*Social Condition,*..... *Present Occupation,*.....  
*Applicant for,*.....

RIGHT EYE.			TEST COLOR.	LEFT EYE.		
Light Chosen in Third Test.	Color Chosen in Sec'nd Test.	Wool Chosen in First Test.	Color Submitted.	Wool Chosen in First Test.	Color Chosen in Sec'nd Test.	Light Chosen in Third Test.
			V			
			Ro			
			R			
			F			
			C			

*Remarks,*.....  
.....  
.....

.....*Examiner.*

*Result,*.....  
.....*Superintendent.*

*Report of Expert,*.....  
.....  
.....

## APPARATUS.

"The material for the first part of the test is quite simple. It consists of all of the wools comprised in the first shades, together with the five test skeins, of the series of wools described by the writer at the 1886 meeting of the society, associated with a piece of dead-black muslin, an explanatory sheet with the colors arranged in their proper order, and a spectacle frame with a movable stop.

"The second portion of the test will consist of a tier of twenty-three shallow, open wooden boxes painted dead-black placed upon a horizontal beam, supported by vertical posts or rods fifteen feet high. Each box is to have its inside surface so arranged as to face an observer placed in a line with the center of the row at one thousand feet distance; every five boxes in the tier being separated by spaces equal to three times their own width, and every fifth box by double this width. Arranged above the middle of these, and at a height equal to six times the height of the lower boxes themselves, there is to be a large revolving box so made as to contain five partitions. The black face of each box is to have a greater space than the largest area of color to be exposed. The inner face of each side of the box will contain a slot, into which a wooden frame containing definitely sized areas of colored bunting equal to that which can be distinguished at the distance chosen by an average normal eye. Each color-frame will have stamped upon it the designation of the contained color in the same nomenclature as employed upon the bangles attached to the wools. The partitions of the upper box will contain the proper sized surfaces of the five principal test-colors that can be recognized by the average normal eye at the employed distance. In addition, there are to be a series of London smoke-tint and translucent glass discs for use in the spectacle frame.

"The additional material for the third part of the test will consist of twenty-three definitely sized chosen areas of transparent colored glass having surfaces composed of concentric

prisms of not sufficient power to cause commingling of diffusion circles with fellow lights. These plates of glass are to be placed in the same character of wooden frames as those which are to be employed for the reflected colors, and each area of color is to have its proper color designation stamped upon its face.

"A series of registry blanks will accompany each set.

#### PROCEDURE.

"The first part of the test is conducted by a modification of the ordinary Holmgren method,<sup>1</sup> and the result for each eye noted by reference to the attached bangle upon the first division of the registry blank. If the examination shows that the candidate has failed, then the entire test can be suspended, as the unfitness for work is plainly manifest, but in order to make the test complete, and thus serve as a check against any future legal disquisition, it is best in all cases to continue just as if the candidate had passed successfully.

For the second test, the fixed apparatus can be placed anywhere upon the railway grounds. The wooden frames containing the match colors of bunting are to be placed in the lower tier of boxes, in any order whatsoever, just as if we

<sup>1</sup>The plan of procedure is as follows. Broad, diffuse daylight is necessary. The square of black muslin should be placed upon a flat table about thirty-six inches from the candidate's eyes, and the wools spread promiscuously upon its surface. The five large test skeins are to be separated from the rest.

One eye of the examinee is to be taken at a time. The surgeon should place one of the large test-skeins a short distance from the other test-skeins (preferably commencing with the "green"). The candidate is now requested to select from the pile of wools one skein which he considers the nearest match to the separated skein and to lay it alongside of the test-skein. Frequently, as Holmgren says, "If the person examined cannot succeed in understanding this by verbal explanation, we must resort to action." We should go through the procedure and thus show the candidate exactly what is wanted, taking care, however, to so disarrange our choice that it will be impossible for him to gain any information by the selection. The lettering upon the tag of the chosen wool is to be registered and placed upon the blank. This finished, the selected wool is to be replaced among the general mass, and the same method of selecting and registry continued with the rose, the red, the blue, the yellow, until the examination is completed.

were to throw the wools upon a table. The five test colors of bunting in the wooden frames are to be slid into the slots in the partitions of the large upper box, and the "V" (pure green) area is to be wheeled into position. The candidate, employing one eye at a time, is now asked to designate by writing the number upon a blank used for that purpose, which color in the lower row (going from his left to his right) is the nearest match to the upper color. This experiment is to be repeated by each test color, preferably, but not necessarily pursuing the order of choice spoken of in the first test, until all has been obtained. These blanks are then to be handed to the examiner, who, after having obtained the names of the numbers chosen for the occasion by the attendant, places them in the second row of the registry blank. To obtain different percentages of light-stimulus and to simulate as near as possible changes in character of weather (fog, rain, etc.), variously tinted glasses can be placed in the spectacle frame, although it would be quite easy, and really proper, to test the candidate during these actual states of weather; yet, as these changes are so uncertain as to frequency and duration of happening, it will be best to limit this variety of experiment to those cases under suspicion.

"The third test is to be conducted in precisely the same manner as the second, except that here the procedure will be made during darkness and by the substitution of the plates of transmitted color, and the lanterns for the areas of bunting.

"An experimental track with five open switches, about a thousand feet away from the apparatus, so arranged that the sidings would pass directly beneath the colors, would be useful after the regular examination had been completed, thus practically testing color-vision from locomotives running at full speed, and deciding the ability to differentiate the ordinary white, red and green signals at safe distances by the choice of track taken.<sup>1</sup>

<sup>1</sup>On account of the above methods being strictly confined to the estimation of the color-sense alone, the necessary apparatus for use in testing visual acuity for form, power and range of accommodation, area and character of visual field, all so



## ADVANTAGES.

"In addition to the advantages shown, to refer to the first test alone,<sup>2</sup> the method may be said to have the following additional uses :

"1. *Much faster in time than any other proper method.* In the first test there are but five selections amongst twenty-three wools, which will at once decide, without continuance, whether the candidate possesses sub-normal color perception for near colors; thus accomplishing in a few moments as much as the Holmgren method.<sup>3</sup> In order to greatly expedite the second and third tests, and in consequence render the entire plan faster than any other, a dozen or more candidates may be examined at the same time, by merely handing them all slips of paper upon which they are all at once to register their names and the number of color or light in the lower row matching

necessary to combine in complete trials for defective vision amongst railroad employes, have been avoided and reserved for another paper in which the method of obtaining the power of the visual sense in its entirety with suggestions as to the employment of better working apparatus in such positions, will be fully explained.

<sup>2</sup>The headings of these advantages, which have been described at length by the writer in the 1886 transactions of the American Ophthalmological Society, are as follows :

1. Five principal tests.
2. The wools are loose and separate.
3. The colors are all of equal relative intensity.
4. Each test-skein has its value expressed.
5. The test can be employed by any educated layman.
6. Accurate notings of passing color changes can be preserved and permanently kept for future comparison.
7. Written and verbal expression of the character and amount of sub-normal color-perception can be given.
8. All the wools are of the same grade of manufacture.
9. All the colors are from vegetable dyes.
10. The use of a black surface or ground for testing.
11. Any order of testing may be pursued.
12. Quantitative determination as well as qualitative determination at one sitting.

<sup>3</sup>The equal intensity of the colors employed destroys any objection to the possibility of escape by reason of fewness of match-skeins.

the upper test color exposed; care alone being taken by proper guards that there is no intercommunication at the time.

"2. *Selection of loose colors at a distance.* There is no other plan that in any way gives choice by loose and changeable selection at a distance. This has been done by naming the colors; so that no matter how they are placed in the tier at the time of examination, they always hold their identity, and can be properly registered upon the blank.

"3. *No necessity for an expert except in doubtful cases.* Every "Color-Blind" candidate, as it were, becomes his own accuser and writes his own individual verdict. The examiner at the station sends the properly filled blanks with his remarks to the superintendent of the division, who marks the case "approved" or "not approved," obtaining, if necessary, in doubtful cases the expert report before signing, whether passed or not.

"4. *Employment of the same character of signal for testing as is used in daily routine.* This is a great advantage, and also avoids any source of error that might be said to arise through the question of the supplemental use of touch or the presence of a characteristic dye odor.

"5. *Placing the eye during testing at a distance necessary for future safety.* This is one of the great claims for the adoption of this method, because by it we thoroughly avoid all dangers that might arise from the escape and employment of a class of subjects possessing what Wilson has so aptly termed "Chromic Myopia."

"6. *Bringing the eye during testing directly before the true condition of weather experienced while it is upon duty.* The color-sense is studied in the same place and under the same circumstances as it has given to it while it is in actual service; this is most decidedly a great gain. Moreover, as has been shown, it can even be made to give the best character of detection in those cases and in those situations where it is most needed, such as engineers and assistants placed upon running trains that are rapidly approaching fixed distant signals.

"7. *Test and match-colors all graduated in proportionate size.*

This is important, as it is a well-known fact that two similar areas of different colors, placed at a definite distance or when surrounded by darkness, give misconceptions as to positions through difference in relative intensities, and thus tend to disastrous result. By carefully grading the test-colors, this complication is avoided, leaving out the question of color, and color alone, to the competing candidate."

## CHAPTER XIV.

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### INJURIES TO THE HANDS AND FEET.

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Employes of railroads receive injuries to the hands and feet more frequently than to any other part of the body. The hand is the most useful as well as the most beautiful member of the body, and, as has been said, distinguishes man, more than anything else, from the lower animal creation. Its beauty of mold, delicacy of outline, and manifold contrivances are certainly marvelous. When, therefore, such a member is injured, and the surgeon is called upon to treat it, he must bear in mind that his most careful attention is required. It is frequently remarked, in speaking of the accident, that "it is only an injury to the hand," or perhaps the foot, the finger or the toe. While these injuries may be slight compared with other parts of the body, so far as danger to life is concerned, yet the usefulness of these members is so great that the careful study of the nature of the injury, and the probabilities of saving them, must all be taken into consideration, and no surgeon should lose sight of these important points, viz., the usefulness, the beauty and symmetry of the member. No part of the hand can be lost without great inconvenience, as well as deformity. These accidents, as stated before, are of frequent occurrence among railroad men, especially among trainmen and machinists. In the report of 100 railroad accidents by W. J. Chenowith, of Decatur, Ill., made to the meeting of the surgeons of the Wabash, St. Louis & Pacific Railway, at

Springfield, Ill., April 30, 1884, he shows that 35 were to the hands and only 4 to the feet, thus confirming the statement above made. The nature of these injuries is always serious on account of the heavy machinery causing them, sometimes producing a contusion of the soft parts without any fracture of the bones. It has been the experience of the author that in many cases the contusion and laceration was quite severe and extensive, yet the bones, if injured at all, but very slightly. The writer has found a greater proportion of injuries to the feet than that given by Dr. Chenoweth, but they are not nearly so frequent as are those to the hands.

In the 12 years of professional experience in this special department of surgery, it is confidently asserted that more than one-third of all the cases treated the injury has been the hands, and about 10% to the feet. This will show how important it is that the railroad surgeon should give special attention to the study of this subject. If the hand, which is so useful, especially to the laboring man, is lost or rendered useless, or the foot becomes permanently crippled, the poor, unfortunate victim is not infrequently unable to procure a livelihood for himself. In many cases this result is inevitable, but many cases occur in which, as the result of careless treatment, on the part of the surgeon, the patient becomes a suffering cripple through life, dependent on his friends or the charity of the public, where a wise, conservative treatment might have restored him to usefulness. There is no class of cases demanding so much careful thought and faithful treatment as that of injury to the hands and feet by the heavy machinery of railway trains. Every surgeon who has had experience in this class of cases will know the nature of such injuries as are caused by the fatal "bumper" or "deadwood."

Dr. Fredrick Cole, in a paper read before a meeting of the Surgeons of the Wabash, St. Louis and Pacific Railway, at Fort Wayne, Ind., June 4, 1883, said:

"Perhaps no class of injuries are more numerous than injuries of hands and feet from railroad accidents. The many railroads of our country, crossing and recrossing all portions of

our land, give employment to a large class of men who are subjected to much danger, especially the trainmen whose business it is to be about the moving cars. In my observation and experience for the last 15 years I find a much greater number of railroad accidents to be of the hands and feet than any other part of the body. This is obvious from the very nature of the occupation—coupling cars; for the least mistake in stepping or movement of the hands may be productive of the most serious consequences. One would think from the extensive railroad system of Europe and America, the thousands of railroad accidents occurring daily, and the peculiar contused wounds from these accidents, while conservative surgery receives its highest rewards in the special line of saving hands and feet, that some monograph on railroad accidents would have appeared by this time. I am not aware that any writer has yet attempted to venture to collate, classify, or even to describe as a separate class, contused wounds from railroad accidents.”

“I have failed to find in any national or international work on surgery any more than a mere mention of railroad accidents, and then only enumerating them with gunshot wounds, or ordinary wounds from machinery. No class of injuries can be more profound than those that follow the catching of a hand between the “bumpers,” or the passage of the wheel of a railroad car over the foot. Of course, in the severer forms of these accidents, where the parts are mangled in a frightful shape, the soft parts completely pulped and the bones ground up, I need spend no time in pointing out the indications, especially to a class of surgeons such as are represented in this body. But many of these limbs, with proper and judicious treatment, which at first inspection would seem almost beyond hope of saving, can be saved and made useful. But to determine how much can be saved and made useful, or whether it is best to amputate, and to what extent, largely depends on the experience and judgment of the surgeon. No man can sit down and “read up” on a railroad accident and mark out a proper line to follow in the amputation of a hand or foot. A



correct decision of these cases calls out the experience and sound judgment, based on the anatomy of the parts. I would make this a rule: Where, after a full and careful examination the hand or foot is injured, and you have a doubt of the propriety of amputation, then give the patient the benefit of the doubt. These two extremities are so far from the vital organs that under proper antiseptic treatment fear need not be entertained that nature will not soon indicate what she can do at restoration. Should amputation not be decided on (and allow me to say the injury to the hand or foot must be very profound which would warrant a primary amputation), then the question of how to dress the limb to get the best results will occupy the first place in the mind of the surgeon."

The views of Dr. Cole in regard to these injuries are fully endorsed. When the anatomy of the parts, the compact, bony structure, the many tendons, delicate nerves and blood-vessels are all considered, the method of treatment becomes a subject of great interest.

TREATMENT.—In the first place a careful and complete examination of the injuries should be made, and in many cases it will be best to give an anesthetic, so that the examination may be made in the most thorough manner possible. In a few instances of severe contusion the skin will be found unbroken. This condition is very deceptive to the inexperienced surgeon, as the subcutaneous tissues will be found lacerated to a variable extent, ranging from an ordinary bruise to their almost complete disorganization; even the skin which is not broken may be so injured as to lose all of its vitality and will ultimately slough. If, after careful examination, it is found that the injury is only an ordinary contusion or bruise, the best treatment will be to cleanse the parts thoroughly with soap and water, to be followed by a solution of carbolic acid. This cleaning must be thoroughly and completely done, so as to remove all foreign substances. Should there be much swelling it will be necessary to puncture the skin freely with a sharp pointed bistoury so that the serum and blood can escape, and apply a warm stimulating liniment or lotion. For a

number of years the following prescription has proved very efficacious in allaying inflammation.

R <sub>y</sub>	Acid carbolic	-	-	-	-	-	ʒij.
	Tinc. arnica,	-	-	-	-	-	ʒij.
	Glycerine,	-	-	-	-	-	ʒij.
	Spts. camphor,	-	-	-	-	-	ʒiss.
	Aqua. dest,	-	-	-	-	-	ʒij.

M.

Sig: Apply by saturating absorbent cotton and covering the parts with cloths wrung out of hot water and covered with oiled silk; changing them every half hour. This will cause a flow of the blood and serum through the incisions made in the skin and will prevent the forming of vesicles which would make their appearance in the course of from twelve to twenty-four hours. This treatment should be continued for at least forty-eight hours, after which it may be discontinued. When the injury is of a more serious nature and the contusion more severe, the same course of treatment should be pursued, but continued much longer, always bearing in mind that no depressent should be used. The foolish practice of applying cold to contused wounds must be unequivocally condemned. It acts only as a depressent, contracting the tissues and in that way causing greater extravasation and strangulation of the parts. Always apply warmth to contused wounds. A very good surgeon in treating contused wounds has, with satisfactory results, employed alcohol diluted with hot water. There is no doubt that the application of a local stimulant in the form of alcohol combined with hot water would prove a valuable application. In some cases olive oil combined with carbolic acid and laudanum has been found very useful when covered over with warm applications. Dr. Beasley of Lafayette, Ind., has found eucalyptus a very valuable remedy in the treatment of contused and lacerated wounds. The formula which he recommends is:

R <sub>y</sub>	Fluid ex. eucalyptus,	-	-	-	-	ʒii.
	Alcohol,	-	-	-	-	ʒvi.

M.

Sig: Apply to the parts affected and cover with absorbent cotton. All tight bandaging must be omitted for the reason that the circulation must not be interfered with. The treatment recommended above will be found sufficient in the ordinary cases of contusion to the hands and feet; but is well to emphasize the importance of making free incisions in these cases for the reason that the areolar tissue and in fact all the structures are not loose but rather dense, and any considerable amount of extravasation would cause strangulation and death to the parts, so the surgeon must make sufficient opening through the skin and tissues for the blood and serum to escape.

But cases are encountered where the deeper structures are involved; not only injuries to the soft parts but also the fracture of the bones, with extensive laceration. In such cases the surgeon will frequently be in doubt whether the parts can be saved, and the question of amputation will have to be considered; yet the surgeon should not be in too great haste to sacrifice a finger, hand, toe, or foot, for in many cases where it was thought impossible to save the parts experience has taught that good results have followed faithful, conservative treatment, and the injured parts have been saved. In the severer forms as described, the hot water applications combined with carbolic acid applied freely for several days has proven of great value. The parts of course must be kept well drained by the introduction of proper drainage tubes. After a few days the parts can be properly adjusted and held in position with bandages and some soft splint, unless the parts are very much lacerated, rendering it impossible, without giving great pain, to apply any firm dressing. In such cases it will be necessary to place the hand on a flat, even cushion or pillow, and by careful dressing bring the fractured bones as nearly as possible in their proper relations. It is much better to have a deformed hand than no hand at all. Every surgeon should keep this in mind. Dr. J. T. Woods, of Toledo, Ohio, who has been very successful and has had much experience in the treatment of railroad injuries, has given a novel, yet very excellent plan of dressing for fingers, which is given in full:

"The treatment of all forms of wounds is, at this time, a subject of discussion, the advocates of Listerism being somewhat numerous and enthusiastic. It is still, however, a matter of doubt whether we have reached that surgical millenium when we can hope for universal repair without pus formation. None will question that this is "a consummation devoutly to be wished" but in the interval of complete and generally accepted demonstration I have to offer certain suggestions as to the method of dressing without special reference to the anti-septic theory. The two points to be considered are the avoidance of pain and the securing of prompt repair, and the pains-taking surgeon with all his ability strives to attain these ends. He recognizes the suffering from an injured finger is just the same as from any other source, and my endeavor in this direction has led me to the adoption of the method now to be described. It is necessary to presume that an amputation has been properly done and that the flaps are of sufficient length to fit easily over the end of the bone without being drawn together with stitches and stretching, and that by appropriate trimming their edges adapt in an even and uniform manner. Any other result is unworthy operative surgery. The stitches and adhesive plaster are then both ignored; in lieu of which, to hold the flaps in place, I take a narrow pledget of absorbent cotton drawn to the required length and, laying it on a solid surface, spread its surface freely with an ointment composed of vaseline one ounce, benzoic acid one drachm. This pledget may be very thin, consisting only of a layer of fibres one-fourth of an inch wide or thicker at the will of the dresser. The flaps being adjusted in the position desired the prepared cotton pledget is lifted from its place by means of the spatula, taken in the fingers and its edges rolled backwards so that the whole presenting surface may be covered with the ointment; it is then applied exactly as adhesive plaster would be, and will be found sufficient to secure the desired end. It is to be pressed snugly over the flap and either end moulded on the parts covered by them. More of these annointed pledgets are now made and applied wherever they will aid in

bringing and holding parts in desired place, and the whole smoothed by gently pressing the fingers over them, care being taken that at no point shall the cotton fibre touch the sensitive surface without the intervention of the ointment. The whole cut surface is not supposed to be covered by these pledgets, and to do this a thin sheet of the cotton sufficient in size is then covered with the ointment and laid over the whole. This is smoothed carefully down and the air will of necessity be excluded, while the flaps are held in place by appliances so soft and flexible that the parts are wholly painless. Over this cotton and ointment dressing a cloth covering is to be applied and to avoid the excess of material, as well as the utter impossibility of applying smoothly a bandage over the end of a finger, I take a piece of cheesecloth, mosquito netting or cretone, about three or four inches square, and in each of two opposite sides cut three tails, the middle tail being in the centre, and about three-fourths of an inch in width. These narrow tails are thus opposite each other, the space between their inner ends being about one-half an inch. The narrow tails are now laid over the end of the stump, the centre or uncut portion on the end, while the extremities are drawn smoothly down before and behind and held in place while the broad tail of one side is brought down and wrapped around the finger, the ends over-lapping each other and covering the narrow tails previously adjusted. This done, the remaining broad tail is brought down on the other side and wrapped around the whole, care being taken that the edges near the end be smooth and without projecting edges.

“Thus the whole is covered and ready for the bandage which is to encircle the stump, but not over the stump. This bandage should never be more than one-half or three-fourths of an inch in width, of thin material, and firmly rolled. The bandaging may be begun at any point, but preferably near the base of the finger, being laid across it in an oblique direction, and the short tail wrapped toward the ends for a couple of turns, when the roll is used to effect a covering of a single layer over the other dressing. Stopping the bandaging at this



point, a thin piece of pasteboard or any thing of sufficient flexibility and firmness to serve the purpose, and about one-half an inch wide, is bent into the form of a capital letter U, and just wide enough at the curve to embrace the dressed finger. This is placed over the end, the legs extending down the anterior and posterior aspects of the finger. The base of this U lies close to but does not touch the end of the finger. It may be wide enough in curve so that it produces no pressure, or in a given case, sufficiently narrow to give the flaps much support. This may be taken advantage of to apply a degree of pressure at any point by placing the appliance in other positions around the stump, and thus aid secured in molding into perfect form.

"The bandage is now to be continued over the whole sufficiently to hold it snugly in place, care being taken to use as little bandage as possible, and that of tein material. It will be observed that no directions have been given to carry the bandage over any part of the hand or wrist to prevent slipping, as otherwise the dressing would do, especially when the patient tries to use his hand. For this direction of the books, I substitute the use of thread, simply improving on the method of our mothers. Cutting off a liberal supply of spool thread or other equivalent, and the patient holding his finger toward me, the middle of the thread is laid across the finger over the point where the bandage ends, so as first to secure it; a tail is thus hanging down on either side. The one on the right is seized by the right hand, the opposite by the left, between thumb and forefinger; the right hand with its thread is carried across and in front of the left, and the thread dropped, the left holding fast. The right hand is now passed back of the left [and next the patient], seizes the thread that it had dropped and brings it back to the right side. Thus the same threads are in the same hands with which the movement began; while they are crossed below the finger. Drawing this taut as desired, both are carried up on corresponding sides of the finger and the same repeated on top, then carried below, looped, and so on over the whole dressing, locking each time



both above and below, and at last tying firmly. The consequences are that all parts are snugly held in place, the thread nowhere becomes loose, and the dressing is just as sure to retain its position as that the method is carried out with reasonable care.

"Judging from description, it is fair to conclude that this procedure is complicated, whereas the fact is that it is the most simple possible. Using the greatest practical brevity in describing, the details of any method seem verbose and confusing, but once done, the whole is so plain, so easy and satisfactory, to both patient and surgeon, that neither will be likely to substitute it by any other. It would also seem to be bungling and excessively warm, both of which inferences are wrong. The supporting absorbent cotton pledgets should be thin, and the portion that is applied over the whole may be quite thin also. A single layer of cheese cloth is then all that is added over the end of the stump.

"The bandage must also be thin and used sparingly. The U-shaped protector described not only aids in supporting where support is needed, but may be used as an aid in molding the end into desired shape. The patient will not allow you to omit it after he has once had it applied, as it almost perfectly protects the tender surface from the little taps and blows it would otherwise receive, and thus saves him from the most vexatious kind of pain, while the method of using the thread as described is simply perfection. Finally, this whole dressing is readily removed by cutting all the threads across, and unrolling the bandages as they were applied and quietly raising the cotton from its place without soaking. It may be best sometimes to run the scissors under its lower edge and cut it through for some distance toward the ends, but trifling care will enable the dresser to remove it without discomfort to the patient. The most tender finger stump may thus be dressed, undressed and redressed at will, without the infliction of the most trifling pain. If these are ends to be desired, then is this detail worthy of attention and practical adoption."

Should amputation be necessary remove only the injured

parts, for with sponge grafting the ends of the fingers may be filled out and smoothed up in a remarkable manner. Dr. Mathews, of Springfield, Ill., in speaking of sponge grafting, says: "This process promises success in recent wounds of the fingers where the bone is laid bare. Two instances have recently come under my notice, the result of the usual careless mode of dressing, in which the bird's-claw appearance, the extreme tenderness and consequent uselessness made it a source of regret that at the outset the finger had not been sacrificed. I am sure that in these cases had all the material which nature supplied been conserved those denuded bones might have been so re-cushioned as to have presented a slightly appearance, and proved useful members, While on railways the majority of accidents to hands and fingers are so destructive and crushing as to necessitate the removal of injured parts, the kinds of casualties above cited are not infrequent, and in many cases where the anticipated danger of septic poisoning not only warrants but would seem to necessitate the removal, such danger might be avoided through antiseptic precautions observed as a part of this plan, and many members restored and made useful, which, under ordinary plans, must have been sacrificed.

Let every surgeon bear in mind that only a small portion of a finger, thumb, or part of the hand will be of good service, and no portion that can be saved and be of any use should ever be sacrificed. When a finger is so injured as to be entirely useless and ankylosed, it had better be removed.

Whenever it is possible to have it so, it is best to have the cicatrix on the dorsal rather than on the palm side of the hand or finger. It is again urged that surgeons shall study, at all times, to save any portion of the hand or finger that can be of any use.

In injuries to the feet the same general course of treatment will apply. But when an injury is of such a serious nature as that caused by the driving wheels of a locomotive, or the heavy trucks of a car, with the inevitable crushing of the bones, severe contusion, extensive laceration, attended with the prob-

ability of a long prostration and ultimate disease of the bones,—in such a case it is far better to sacrifice the foot than to allow it to remain. The perfection attained in the manufacture of artificial limbs, especially the foot and leg, is such that a person will fare much better with a good artificial limb than with a diseased or greatly deformed foot. In all operations on the feet the same precautions as noted in operations on the hands must be observed, especially that of having the cicatrix on the dorsal instead of on the palm side. Many persons have been great sufferers through life through the negligence of the surgeon to observe this highly important precaution. Whatever the nature of the injury, the surgeon must not allow the patient to use either the hand or foot too soon. Especially is this important in injuries to the feet, where the bones and the periosteum have been injured. Although the parts may be healed there is danger that they may become swollen, followed by a sub-acute inflammation, which finally becomes chronic, the patient suffering constantly, the tissues all becoming enlarged and filled with inflammatory deposits. It is well, therefore, always to enjoin complete rest to the injured limb; if the foot, have it elevated, the patient resting in a horizontal position, if the hand and fingers it should be suspended in a sling. The hand should not be permitted to hang down, or the foot to be raised, until after the healing process is fully completed. Should there be developed at any time a sub-acute or chronic inflammation, the treatment should be complete rest and the application of the following ointment to the limb:

R <sub>y</sub>	Oleate hydrarg,	-	-	-	-	-	5iij
	Lanoline,	-	-	-	-	-	5ij

M.

Sig. Apply freely to the parts affected every three hours.

This has been found to be very efficacious in reducing the inflammation and causing the absorption of inflammatory deposits. In all cases much care must be given to the general health of the patient. He should be sustained by good nourishment and in many cases the muriate tincture of iron, with

quinine, in good doses will be beneficial, and should be given. If the patient is in the hospital he should be kept there until he has fully recovered. It is a mistake to allow patients with injured hands or fingers the full liberty to go where they please and only present themselves at the hospital at the time for dressing their wounds. Many serious results frequently follow such privileges. The loss of fingers and hands is sometimes occasioned by an erysipelous inflammation, which, no doubt, results from the exposure of the patient in going out too soon, or visiting saloons, and, as occasionally occurs, imbibing freely of intoxicants.

It is always better to have the patient remain in doors until entirely well, unless it should be to take moderate exercise in the hospital grounds, and that not without the consent of the attending surgeon.

## CHAPTER XV.

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### RAILWAY CONCUSSION OF THE SPINE.

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The subject of railway concussions of the spine has attracted much attention among surgeons, especially those who have had to treat patients injured in collisions. The experienced surgeon well knows the great danger there is in even a very trivial injury to the head, which may result in serious consequences; and so with injuries to the spine. The brain may become affected with some form of inflammation which may prove serious from a very slight injury, and so with the spinal cord. In fact the experience of many surgeons is that it is more liable to take on inflammatory action after an injury than the brain.

These injuries are very troublesome to the railway surgeon and require careful study in determining their true nature and extent, for the reason that in many of these cases the symptoms are magnified very largely by a prospect of securing a large sum of money from the railway company upon whose train they received the injury.

Prof. John Erichsen, in his work on "Railway and Other Injuries of the Nervous System," says: "These concussions of the spine and the spinal cord not unfrequently occur in the ordinary accidents of civil life, but from none more frequently or with greater severity than in those which are sustained by passengers who have been subjected to the violent shock of a railway collision; and it is to this particular class of injuries

that I am especially desirous of directing your attention. For not only have they, in consequence of the extension of railway traffic, become of late years of very frequent occurrence, but, from the absence, often, of evidence of outward and direct physical injury, the obscurity of their early symptoms, their very insidious character, the slowly progressive development of the secondary organic lesions, and the functional disarrangement entailed by them, and the very uncertain nature of the ultimate issue of the case, they constitute a class of cases that often tax the diagnostic skill of the surgeon to the very utmost. In his endeavors not only to unravel the complicated series of phenomena that they present, but also in the necessity that not unfrequently ensues of separating that which is real from the symptoms which are the consequences of the exaggerated importance that the patient attaches to his or her injuries, such practical skill and judgment is required."

The above quotation from this well-known surgeon and author coincides with the experience of all who have had anything to do in the management of this class of patients.

A few years ago a passenger on a local freight train received a slight shock in an accident occasioned by an engine coming up and striking the rear end of the caboose so that it was raised about two feet off the rails, while the front wheels or truck remained on the track. The shock was so very slight that while the coach was well filled with passengers this was the only one injured, and he did not complain until some time afterwards, when he was no doubt informed by some one that he could recover damages from the railroad company. Then all of the symptoms of concussion of the spine followed, and continued until a jury in the United States Court gave him a judgment against the company for one thousand dollars, when all the symptoms of "spinal affection" disappeared. In this case the writer asserted that there was no concussion and no injury, and yet some good, honest, conscientious surgeons believed the man was seriously injured and so testified. This case is given out of very many that have come under personal observation and management, to illustrate the great difficulty,



as stated by Dr. Erichsen, of "separating that which is real from those symptoms which are the consequences of the exaggerated importance that the patient attaches to his injuries. There is no class of cases which give to the railway surgeon so much trouble, and in which they are more frequently called upon to testify in our courts than those of supposed injury to the spine. Hundreds of thousands of dollars are annually paid by the railway companies of this country in the settlement of claims of personal injuries where the lesions are claimed to be in the spine, and in the majority of cases no injury exists at all. Erichsen, in referring to this point, says:

"The secondary effects of slight primary injuries to the nervous system do not appear as yet to have received that amount of concentrated attention on the part of surgeons that their frequency and importance demands; and this is the more extraordinary not only on account of their intrinsic interest attending their phenomena, but also from their having become of late years a most important branch of medico-legal investigation. There is no class of cases in which medical men are so frequently called into the witness box to give evidence in courts of law, as in the determination of the many intricate questions that often arise in questions for damages against railway companies for injuries alleged to have been sustained by passengers in collisions on their lines; and there is no class of cases in which more discrepancy of surgical opinion is elicited than in those now under consideration."

It is not because surgeons are dishonest that so much difference of opinion is found among them but from the fact that the cases are quite difficult to determine, and it requires the most careful study of each case with all the symptoms and phenomena which present themselves. Every surgeon called to examine a case of this kind should give it his most careful study and thorough investigation; not relying on the statements of the patient, especially if there is a suit for damages pending. In all such cases the history of the case should be carefully examined. How was the injury received? What position was the patient in at the time of the collision? Was the force

great? How soon did the symptoms manifest themselves after the injury, and what was the character of the suffering? How long did it continue? In fact the most thorough and careful investigation of the early history of the case should be made, and if an intelligent, conscientious physician and surgeon has had the case under his care, it is always well to get at the facts from him; and yet in some cases the relations of the attending surgeon or physician to the family or patient is such that many things have been obtained in relation to the case he does not feel at liberty to state, consequently in the great majority of these cases the surgeon will be compelled to rely upon his own investigations. On this point Erichsen says :

“It is with a view and in the hope of cleaning up some of the more obscure points connected with these injuries that I bring this important subject before you; for I believe that as these cases come to be more carefully studied, and consequently to be better understood by surgeons, much of the obscurity that has hitherto surrounded them will be removed, and we shall less frequently see those painful contests of professional opinion which we have of late been so constrained to witness in the courts of law; that discrepancy of opinion as to relations between apparent causes and alleged effect. As to the significance and value of particular symptoms, and as to the probable result in any given case must always exist, there can be no doubt, more especially where the assigned cause of the evil appears to be trivial, when the secondary phenomena develop themselves so slowly and so insidiously that it is often difficult to establish a connecting link between them and the accident. And for the existence of such a discrepancy of opinion, and for the expression of it, if necessary on oath (as a matter of opinion merely) any undue amount of blame has been cast on members of the medical profession.”

As stated before, it is not because members of the profession are untruthful or dishonest, but because they have not given the case that careful thought and investigation necessary to satisfy themselves to give correct evidence to the

courts. It may, however, be observed that in some cases it really appears that the surgeons have taken one or the other side of the case, or rather the theory as adopted either by the prosecution or the defense, has been laid down by some surgeon and it would appear that really the surgeons have become parties to the suit, apparently as much interested as the attorney who has a contract for one-half of the judgment obtained, as is known to be the fees received by some attorneys in prosecuting the railway companies in this country. No member of the profession should so prostitute his high standing by becoming so much interested in the success of any case in court as to become a party to the suit (that is apparently). When required to give testimony it should only be as to real facts as known by him in regard to the case, or by judiciously and carefully answering all hypothetical questions.

In well-marked and clearly defined cases of injury when the physical lesion is distinct (as in a fracture) or the general symptoms unmistakable, as in the loss of sight or hearing, or in the sudden and immediate induction of paralysis, no discrepancy of opinion can or ever does exist; and there is no hesitancy in declaring that in at least nineteen-twentieths of all the railroad accidents referred to surgeons of experience for arbitration or opinion, there is no serious difference as to the real nature of the injury sustained, or as to its palpable result on the patient, either locally or constitutionally, immediately or remotely. But in a certain small percentage of cases in which, as has already been said, the relation between alleged cause and apparent effect may not always be easy to establish; in which the symptoms come on slowly and gradually, and may possibly be referable to other constitutional conditions, quite irrespective of and pre-existing to the alleged injury, and in which the ultimate result is necessarily most doubtful, being dependent on many modifying circumstances; in such cases I say discrepancy of professional opinion may legitimately, and, indeed, must necessarily exist. There is no fixed standard by which these points can be measured. Each practitioner will be guided in his estimate of the importance of the present symptoms, and of the

probable future of the patient, by his own individual experience or preconceived views, on these and similar cases.

No surgeon or medical officer of a railway company should ever assume to be the agent to settle the terms of compensation in cases of personal injury; or in other words he should not assume to be what is known as a "detective" to endeavor to entrap the party to give some expression which could be used against the claimant, and in favor of the company. The surgeon making the examination should only endeavor to ascertain the true nature of the case, and in making the examination it is always best, whenever it can be so, to have the medical attendant present and have him witness the examination, and hear the questions asked the patient, but it is not always best for the surgeon to enter into a consultation with the attending surgeon, for the reason that opinions on medico-legal questions are always best given on the witness stand.

The examination should not be unnecessarily prolonged, yet it should be made thorough, and if possible, without giving pain or causing mental excitement.

It is always well, if it can be done, to make a report of the case at once, while at the bed-side, giving: The patient's account of the accident, and the subsequent and present symptoms, with a complete history of the case as obtained from the medical attendant; the condition in which you find the patient, noting all the symptoms or signs of injury; and the opinion you may have as to whether the symptoms are from the effects of the injury, and if so, what in your opinion will be the probable results; will there be any permanent effects follow the injury, or will complete recovery take place in the case.

This examination should always be made at an early date, as soon as convenient after the accident. Should the surgeon for the company be called as the medical attendant, he should be very careful to note every sign or symptom and make out his report at once, not for the purpose of "defrauding the patient, but for the purpose of enabling himself and his fellow-practitioners in case of suit for damages, to give correct evidence in court when called on.

The actual question of pecuniary compensation does not concern (or should not) either the medical attendant of the patient or the surgeon employed by the railway company. They are only to investigate and bring forth the facts in the case, so that justice may be done both to the party injured and the company.

By an early investigation in all of these cases and in making it thoroughly and carefully, the practice of fraud would be rendered less liable and by an accurate statement of the symptoms of the case and a perfect and complete knowledge of the case would avoid much conflict of medical opinions. Not all who exaggerate all of their symptoms in these cases of concussions are intentional malingerers. There are injured persons who have no fraudulent designs, and yet unintentionally exaggerate all of their symptoms and suffering for the reason that their minds are all the time directed to their sufferings, especially while a suit for damages is pending. The great anxiety, the frequent consultations with their attorneys, and perhaps the prolonged examinations of the surgeons, is calculated to keep them in a constant state of nervous excitement, and in my judgment, many of these patients actually believe that they are seriously injured, when in fact there is no injury at all.

Yet we have found quite a number who intentionally and with a purpose, exaggerated all the symptoms and in some case where no injury was received, but where a slight collision occurred, or a car had left the rails, causing a slight "shaking up," where no injury was complained of until after several weeks, when it was learned that the car-inspector had condemned the car on account of flattened wheel, thus making the company liable for damages, when severe pain and other symptoms of local injury in the back were complained of and continued until the claim was settled, when all symptoms of injury disappeared. In the many cases that have come under the observation of the writer not more than 5 per cent are genuine, where no effort is made to exaggerate the symptoms. From all these facts how important that the surgeon who is intrusted with the care of the injured and the interests of the company employ-



ing him, should be careful in the investigation of every case of alleged injury, especially when symptoms of injury to the spine or nervous system are complained of.

Dr. William A. Hammond, who has given this subject much thought and investigation and who has had an extensive experience in the management of these cases says: "Of late years a new class of malingerers has arisen. This is composed of the people who, when any accident happens to a railway train, steamboat or other conveyance owned by a corporation or rich person at which they are present as passengers, pretend that they have been seriously injured and forthwith bring suit against the proprietors in immense sums for damages. A smattering of medical knowledge is very soon acquired by these people during their examinations by their physicians, and they are thus often enabled to cut a pretty good figure before a jury. I do not think it is at all difficult to detect these impostors.

"It is rarely the case that they are so consistent in their detail of alleged symptoms and in their conduct as to deceive a medical man thoroughly well skilled in his profession. Besides this, they generally over-act their part in their efforts to deceive, and, if subjected to close scrutiny for some considerable time, and at periods when they do not suspect that they are watched, scarcely ever fail to show themselves in their true colors.

"Not long since I was applied to by a young man, who informed me that, about a month previously, in getting off a street railway car, he had been violently thrown to the ground, so that he had wrenched his back, had become partially paralyzed in both legs, and had, besides, sustained serious internal injuries. In addition to wanting my professional advice, he desired an examination, with a special view of having me testify before a court in a suit for \$20,000 damages, which he intended to institute against the railway company. I caused him to take off his clothes, and I found at once that there was no emaciation. On the contrary, his body was remarkably well nourished. He complained of pain in the upper region of his spine, and screamed in apparent agony when I slightly



touched that part of his body. It seemed to me then that there was an unusual degree of sensitiveness, and not at all such as would have been developed had he been really injured in the way he described. The grasp of his hand was very weak, but at the same time his muscles were large and well formed.

"I was satisfied even at the time that he was making the most of his condition, if not actually deceiving me. I next asked him to walk around the room till I told him to stop. At first he tottered over the floor as if about to fall at every step, and complained of great pains in his legs. As he continued walking, however, I kept him in conversation so as to divert his mind from himself. As a consequence he was thrown off his guard, as I expected he would be, so that after a half dozen turns his gait was measurably improved, and at times was as good as it ever had been. Of course, if there had been any real paralysis, every step he took would have added to his lameness. Some other methods of examination with instruments of precision placed the fact of his fraudulent pretensions beyond a doubt. I then accused him of deception, and recapitulated to him the points which by his insufficient knowledge of the subject had led to his detection. After numerous protestations he confessed that he had been drilled to simulate spinal injury with a view of defrauding the railway company."

To give a clear and comprehensive definition of the term, "Concussion of the Spine," is not an easy task; yet it may be stated that it is generally construed by surgeons to indicate an injury to the spinal cord, inflicted by external violence, but independent of any injury to the vertebra of the spinal column; a jar received by the spinal cord, on account of which the structure is more or less deranged and its functions greatly disturbed, manifested by symptoms of partial loss of sensation and motion in the lower extremities. On this point Erichsen says: "In fact it appears to me that surgeons and writers on diseases of the nervous system have included four distinct pathological conditions under this one term, 'Concussion of

the Spine,' viz.: 1st, a jar or shake of the cord disordering to a greater or less degree its functions, without any obvious lesion cognizable to the unaided eye; 2nd, compression of the cord from extravasated blood; 3rd, compression of the cord from inflammatory exudations within the spinal canal, whether of serum, lymph or pus; and 4th, chronic alterations of the structure of the cord itself as the result of impairment of nutrition, consequent on the occurrence of one or the other of the preceding pathological states, but chiefly of the third. These various conditions differ remarkably from one another in symptoms and effects, and have only this in common, that they are not dependent upon an obvious external injury of the spine itself, as the laceration or compression of the cord by the fracture or dislocation of a vertebra. Concussion of the spinal cord is a pathological condition caused by a severe blow or injury on the back, which has long been recognized by surgical writers; but most, if not all, the older writers regarded the condition as the result of direct injury to the spine, and not of an indirect force. When the anatomy of the spinal column is fully understood, and the structure of the cord and its protection within this bony canal is remembered, it will be readily seen how difficult it is for the cord to be injured by indirect force. The spinal column is so flexible that it will bend like rubber, and yet is so stiff that it will bear heavy burdens, but the cord is suspended within this protected canal so that it is very doubtful whether there is ever any injury to it without direct force, for the reason that the concussion or jar which would cause such serious shaking up of the spinal cord would also produce serious lesion of the brain, and the probabilities are, much more readily, so that is unreasonable to suppose that all the symptoms or pains complained of in the back by those who have been the subjects of injuries from a collision of railway trains can be attributed to the shock. Dr. F. L. Mathews, of Springfield, Ill., in a paper read at a meeting of the surgeons of the Wabash, St. Louis & Pacific Railway, April 30, 1884, on "Surgeons' Duty in Railroad Spinal Injuries," says:

"First in importance is the physical welfare of the sufferer; to see that every call for immediate action meets a prompt response. This will include the resuscitation from violent shock, staunching dangerous hemorrhages, applying temporary support to fractured bones, removal to comfortable surroundings, etc.; in a word, to render such instant relief as comes within the province of our noble art, directed by true skill and prompted by the purest human sympathy. This much we owe to the unfortunate victims. Does this comprise our full duty? A little forethought right here will often tend, and justly, too, to grateful recognition on the part of those whose interest it becomes our duty to subserve, to the extent at least, of watching against peculation and fraud. Unpremeditated statements are the most truthful and reliable. Verbatim records taken upon the spot often furnish rebuttal evidence that overthrows theories subsequently manufactured to meet anticipated emergencies. While this in no wise detracts from the invaluable services rendered the afflicted, and in no respect offers an obstacle to the operation of strict and impartial justice, it does contemplate protection against fraud, by strict conformity with the letter and spirit of the golden rule. Varying circumstances, alone, will decide as to the most important data to be secured. I need only drop a hint as to the general procedure and requirements. Get if possible the injured person's own statement, including velocity of train, his position therein, the direction of the force producing the injury, the nature and extent of all external signs of same, also what may be gathered from eye witnesses unhurt, while reverential awe and overflowing gratitude for self-preservation prompts to honesty both of deed and purpose. Be not too chary of a little labor, but bear in mind that items which at first might seem unimportant often prove the very links that perfect the chain. In most injuries the result of direct force, producing either contusion, laceration or crushings, examination readily suggests the necessary surgical attention; but in casualties with no external signs of violence, but which involve the central nervous system, more time and greater care is necessary to

determine the nature, locality and magnitude of bonafide cases, as well as to guard against imposition, which I am ready to believe has been successfully practiced. Veritable cases of spinal trouble even among those who at the time congratulated themselves upon their escape, have superinduced, and have proved serious and intractable. Such cases furnish an opportunity for the sinister-minded to attempt deception, and call for caution and professional keenness. Such developments should excite suspicion; enough, at least, to prompt the closest scrutiny, to the end that all attempts at real deception may be promptly checkmated and exposed. While no definite instruction can be given as to the management of these exceptional cases, the surgeon, in possession of all available data bearing upon each, has an opportunity to draw upon his inventive genius, and his conduct may be so well timed and discrete as to simulate the healing virtues of his best remedies. Bear in mind the necessity of much thought and little talk, that mischief comes from thoughtless talk, rather than thoughtful silence. No class of injuries demands nicer discrimination than those of the spine, implicating the cord. The whole length of the spinal cord shows a monotonous anatomy; The same elemental structure pervades, as far as we know, its entire length. The same may be said of its membranous coverings, both as to structure and arrangement. The same violence that has produced injury to one part would, if applied to another, induce the same morbid changes or pathological conditions, but the outcrop of symptoms will depend upon the seat of injury. The precise character of these will afford rational hints as to the nature, as well as the locality, of the morbid processes producing them. Spinal troubles from accidents will hardly offer the same difficulty in diagnosis as those diseased conditions, which we often meet—the remote cause being, perhaps, as much of a mystery, as the disease itself. In railway surgery we contemplate accidental cases, developing immediate symptoms—the spine, previously healthy. Sudden developments, from localized injury, whether of an extrinsic or intrinsic character, will constitute a clearer index

of the morbid process than those which supervene upon progressive disease.

It is no exhibition of ignorance, but rather of frankness, to admit that there are in grave injuries certain combinations of symptoms, common to varied diseased conditions, which cannot, with any degree of certainty, be promptly differentiated, and which the lapse of time alone makes clear. Paralysis of sensation and voluntary motion supervene upon compression of the cord, no matter what the immediate cause. The slowness or promptness with which it appears, the amount of territory it invades, the length of time it continues, the mode and manner of its disappearance, all teach us a lesson which could not be foretold, but when learned, furnishes the solution to an interesting but difficult problem. Injuries, as well as diseases of the spine and its appendages, have not received the same attention, or been subjected to the same persevering research, as obtains in other medical and surgical investigations, by reason of the prevalent impression of their hopeless character. The neglect as to the spine is even more apparent than in troubles involving the brain. The proper surgical attention in cases of violence to the head, producing compression, by fracture, and depression of the skull, have always been promptly rendered, and, as a rule, governed, of course, by temperament, tendency to inflammatory action, amount of local disorganization, etc. in each individual case, with most gratifying results.

The spinal cord, as an appendage of the brain, is no less delicate or sensitive; subject to the same injuries and the same morbid processes, liable to the same functional derangements but circumscribed in proportion to the remoteness of seat of injury from the great center upon which it solely depends. The effects following compression of the brain are so universal as to simulate death, and demand at once any warrantable procedure for its relief. In spinal compression that same similitude of death obtains, in every part dependent for its functional life upon that part of the cord below the point of injury; but the freedom of all remaining functions so robs the case of press-



ing importance as to invite moderation, and in many cases, I believe, actual neglect. In all cases of evident compression, the removal of the cause is the point at issue. If it be from the effusion of serum-blood, or the result of inflammatory action, the surgeon may at least guard against further aggravation of the cause, and, by the free use of local and constitutional means, aid nature's efforts, the all important factor in the curative process. If, with this train of symptoms, actual deformity co-exists, in the light of statistical knowledge upon this point, past timidity, in the presence of either spinal luxation or fractures, must give place to positive efforts at reduction, the only hope of relief. While the records show but one case of immediate death from such manipulation Dr. Ashherst reports thirty-four cases thus treated with but four failures. In many cases the success was indicated by an audible snap, and in several the paralysis was instantly relieved. The spine is the grand central support of the entire osseous system, and the cord, under control of the will, the battery power of all voluntary, muscular movement. It takes cognizance of all muscular effort, whether voluntary or involuntary. See muscular tonicity produced by anticipated efforts, serves as a protection against shock or concussion, and, with such preparation, the sudden expenditure of force or resistance against external momentum that would fall harmlessly might, coming unexpectedly, and during perfect relaxation, more especially if applied so as to produce a twitching wrench, be the occasion of such violence to the whole spine as to induce permanent disease. There may be a condition thus induced that slowly develops, the first noticeable evidence varying from a few moments to days or weeks after the accident. All these conditions might readily obtain in railway collisions. The violence, though governed by circumstances, velocity, weight of train, etc., is never slight, and the injury done to individual passengers, from this cause alone, will depend on the position of the body, and the disadvantageous application of the force. The "Railway Spine" of which Mr. Erichson speaks is thus produced, and accounts for a train of symptoms that some-



times supervene when not only was there no external evidence of accident, but the victim under the confusion and excitement of the moment was, for a time, able to minister to the wants of sufferers, entirely ignorant as to his own mishap. One such, the wife of a prominent employe at the W., St. L. & P. Railway headquarters in this city, who was a passenger in a Pullman car thrown down an embankment near Kansas City, last summer, came under my own observation during the past winter. She was extricated from the wreck and walked to a neighboring house before realizing that she had sustained an injury, from which she has not yet fully recovered. Symptoms in these cases are not so characteristic as obtain in marked spinal injuries, but simulate general prostration, great loss of muscular power, and are often accompanied with strange perversion of the special senses. There is some question as to the existence of an absolute permanent disease, some eminent writers claiming that such instances denote nervous shock only and are susceptible of treatment, and under favorable circumstances may recover. While it may be true that serious results sometimes follow causes apparently slight, and that railway collisions offer facilities for every grade of severity, from the slightest to the most aggravated, it behooves the railway surgeon to exercise great caution and wait further developments ere he settles upon "railway spine" as his diagnosis, since similar neurotic cases were not unknown even before the days of railway surgery. Medical literature is still limited and unsatisfactory upon this important class of injuries. Practical generalities seem to have been the purpose of our best and most reliable writers."

As stated, the great difficulty in all of these cases is to make a correct diagnosis, and do justice to the patient. Every case demands a careful investigation, and no surgeon can, in a careless and indifferent examination, arrive at a correct diagnosis of the case. He should give himself plenty of time to investigate every symptom, both objective and subjective, acquiring a full and complete history of the accident in all of its details, the position of the patient at the time the injury was received,

noting carefully the first symptom complained of and the progress of the case.

**TREATMENT:** When there is any lesion or injury to the spinal cord the patient should at once be placed in a recumbent position on a good, soft, but firm, mattress and in a well ventilated room. It is very important that the surgeon should carefully examine the room and bed to know that the patient will be comfortable. When the shock is severe it will be well to administer a diffusible stimulant, but not large doses of alcohol. Hot coffee, Spts. Ammonia, ar. T. Digitalis, Nux Vomica, and Ether Sulphuric, with small quantities of good brandy, is preferable to the large doses of alcoholic stimulants usually administered before the surgeon arrives. When the patient is seen before anything has been given him, especially if the action of the heart is quite feeble, the following will be found very valuable :

Ry.	Spts. ammonia aromatic,	-	-	-	-	ʒiv.
	Fl. Ext. nux vomica,	-	-	-	-	ʒss.
	T. digitalis,	-	-	-	-	ʒj.
	Ether sulph.	-	-	-	-	ʒijss.
	Syrup simplex,	-	-	-	-	ʒij.
	Spts. frumenti,	-	-	-	-	ʒj.
	M.					

Sig. Two teaspoonfuls every half hour with hot coffee.

If the patient is suffering much pain a hypodermic injection of morphia and atropia may be given with good results. The patient must be kept free from excitement, consequently only those who have charge as nurses should be admitted to the room. In from six to ten hours the surgeon should examine the bladder and if found distended with urine should at once use the catheter, as in all of the cases where there is injury to the spinal cord the urine will be retained. Surgeons sometimes neglect to look after this, to the great injury of the patient. Prof. Gross says: "The treatment of concussion of the spinal cord must be conducted on the same general principles as concussion of the brain, by recumbency and cordials or mild stimulants during the stage of depression, and by great

vigilance during the period of reaction, lest it should transcend the health limits and pass into inflammation. Should this untoward circumstance arise, it must be promptly met by the usual antiphlogistic means. A full anodyne with the addition of a little tartrate of antimony and potassa will generally speedily arrest the irritability of the bladder and the tendency to inordinate renal secretion."

In the treatment of the secondary effects of spinal concussion, especially when there is partial paralysis of the lower extremities, potassa iodide should be given in decided doses and continued for at least thirty days before electricity and strychnine are employed for the reason that if there is any effusion, clot, or inflammatory deposit producing pressure, the latter remedies will only do harm; but the iodide of potassium will cause absorption of the serum or deposit and relieve the pressure. Then electricity and strychnine can be used and found very valuable. In the majority of cases of persons complaining to the surgeon of "chronic concussion of the spine" it will be found that they have been carefully taught by some attorney to "play their part well," but the careful surgeon will be enabled to detect the malingerers if he will only take sufficient time in his examination. Of course such cases will not require any treatment. But where there has been an injury to the spinal cord the surgeon will find great difficulty in the successful treatment of the case.

We make the following extract from a paper by William A. Hammond, M. D., Surgeon-General U. S. Army (Retired List):

"Is there a class of injuries of the spine produced by railway accidents, the symptoms of which are entirely subjective? In other words, are there any spinal affections caused by collisions and other mischances which are evident only to the alleged sufferer, and which cannot be detected by the most careful examination on the part of the physician or surgeon? If there were not at times extraordinary motives for simulating such diseases, the question would not probably have to be asked. But with soldiers and sailors, prisoners, the members

of beneficial societies, school children and railway passengers a motive for deception often exists, and hence in the interest of justice to the plaintiff and defendant in suits for damages the subject is one of great importance, to say nothing of its scientific relations.

"For instance, a patient comes to his physician and says he has a pain in his back. He walks in a bent position, he shrinks when pressure is made on the alleged seat of pain in the spine, his face wears an expression of weariness or suffering, his urine dribbles from him or is retained till drawn off by the catheter. Some of these symptoms are subjective, others are objective; but there is not a single one of these latter which cannot be assumed, and of all the phenomena exhibited by the patient, every one may be a counterfeit.

"Now if the individual apparently suffering from this combination of symptoms has no obvious motive for deception, we take all his statements with full faith in their correctness, and do not stop to ascertain whether or not he is endeavoring to impose upon us by shamming lameness, or incontinence or retention of urine. In fact, if there be no incentive to fraud there is every reason why he should not attempt to impose on a medical practitioner. But if he has recently been a passenger on a railway train when an accident occurred by which he received a concussion or shock, and we are aware that he has instituted, or is contemplating instituting, a suit for damages in a large sum of money against the company, we should be derelict in our duty if we did not test by every means in our power the truth of his statements and the reality of the obscure phenomena; and if we did, the probability of arriving at absolute correctness would be very slight, unless we had repeated opportunities of observation, for a painful expression of countenance may be assumed, a bent position of the body and lameness are easily counterfeited, and even incontinence and retention of urine may be voluntary.

"Or the case may be much milder and still sufficiently severe to cause great inconvenience and suffering. A few years ago I was consulted at the instance of my friend, Dr. J. Marion

Sims, by a young lady who had for several months suffered acutely with a pain in the lower part of the spine, which was apparently directly the result of a fall on the ice, by which the end of the vertebral column was brought into violent and sudden contact with the hard, frozen surface of the ground. For a moment she was stunned and was unable to walk or even to stand, but in a short time not exceeding half an hour she walked a few steps to a carriage, and on reaching home at once went to bed. The following day she could walk, though with some difficulty, but there was a constant pain experienced in the lower dorsal region which was aggravated on movement of the body. This pain, when I saw her several months afterward, had not left her for a moment during the time she was awake. It was of a dull aching character, and was always increased by fatigue. Indeed, very slight muscular exertion, such as walking a few hundred yards, or playing a game of croquet was sufficient to render it exceedingly distressing. Beyond this there was nothing. There was no paralysis, no anesthesia or hyperesthesia of the limbs, menstruation was regular, digestion was not interfered with, sleep was natural, and she looked the very picture of health. Here there was no apparent reason for questioning the patient's veracity; her statements were accepted by her physicians, and she was placed under such treatment as appeared to be indicated. But suppose for the moment that she had complained of the pain immediately after having been subjected to the shock of a railway accident, how different would have been the views of those medical gentlemen who might, in her and the company's interests, have subjected her to examination. One set of physicians, believing her assertions of the existence of a continual pain in the spine, would have testified to spinal injury, while the other, discrediting her allegations, would have seen only an attempt to defraud a corporation.

"Again there are cases in which there is undeniable injury, the effects of which are at first very clearly manifested by subjective and objective symptoms, but in which subsequently there may be reason for believing in the fact of complete re-



covery, but in which, nevertheless, the patient continues to complain of pain and to show material derangement. It is certainly true that where there is no motive for deception, very severe symptoms are speedily recovered from.

"Thus Ashhurst (*Injuries of the Spine, etc.*, Philadelphia, 1867, p. 8,) cites the case of a male child, *æt.* 2 years, who was admitted into the Pennsylvania Hospital, November 13, 1861, having a short time previously received a severe blow upon the back. There were no external marks of injury, but the lower limbs were paralyzed, doubling up upon themselves when an effort was made to place the child in an erect position. He was discharged cured after two months, his treatment having consisted in little else than rest in a recumbent posture.

"A case has recently come under my observation, in which the patient, a stout man, *æt.* 30 years, fell backward from the side of a staircase which was without a railing, and struck his back against a box some ten feet below. There was complete paralysis both of motion and of sensibility in the lower extremities; the bladder was paralyzed, as was also its sphincter, and there was severe pain at the lower dorsal and upper lumbar region of the vertebral column. These symptoms were present from the very first, and continued with their initial severity for several weeks; amendment then began, and after the lapse of about four months, the patient was apparently as well as he ever had been.

"My own case is to the same effect. In going down a staircase at Nashville, in the winter of 1864, I knocked my head against a beam and fell, striking my back against the edge of the stairs several times as I went to the bottom of the flight. I was unable to rise, in fact, was completely paralyzed, both as regarded motion and sensibility, and was carried upstairs on a stretcher and laid on a bed. For a few hours there was paralysis of the bladder, but power was regained before night. The lower extremities remained incapable of any motion for seven days; on the eighth day muscular power began to reappear in the flexors of the toes and steadily advanced, but it

was over four months before I was able to walk without crutches, and several more before recovery was complete. During the first month the electric contractility of the paralyzed muscles was markedly diminished.

"Again, there are cases of spinal injury in which the symptoms do not ensue immediately, but they are developed at some subsequent period. Several such are cited by Erichsen,<sup>1</sup> in his recently published work, and quite a number have come under my own observation. Some very interesting instances of the kind are detailed by Leudet,<sup>2</sup> in all of which recovery took place. This last is not, however, as we will hereafter show, by any means an invariable result of Leudet's cases; the following are especially interesting.

"M., a man in good health, jumped from the quay to the deck of a ship, a height of about twelve feet, and at once experienced a sharp pain in the sacro-lumbar region. He however continued to work. The morning after the accident he still felt the pain in the back, and besides, experienced a gradually increasing degree of weakness in both legs. He was nevertheless able to walk, though with difficulty; but throughout the whole time had no numbness or pain in the limbs. The power of motion, however, soon began to appear, and on the eighth day he was discharged from the hospital entirely restored.

"R., æt. 34 years, while engaged in unloading a vessel, fell to the ground from a wagon a distance of about a metre, striking on the hands and feet. He arose without assistance, and felt no inconvenience except a tingling in the right knee. He walked some twenty feet and lay down on rather damp ground, where he remained for less than half an hour. He then, feeling no pain, rose to the sitting posture, then stood erect; but on attempting to walk, found he could not on ac-

<sup>1</sup>On Concussion of the Spine, Nervous Shock and other Obscure Injuries of the Nervous System, London, 1875.

<sup>2</sup>Recherches Cliniques esu la Congestion de la suite de chutes on d'efforts. *Cliniques Medicale*, Paris, 1874, p. 384.

count of the weakness of both legs; supported by two men he managed to reach his home. During the night his legs became so weak that he was unable to turn in bed, and on awakening in the morning he found the arms also measurably deprived of power. There were neither urinary nor rectal troubles. The paralysis continued to increase for several days, then at the end of two weeks there was marked amelioration; but it was not till nearly three months had elapsed that he was discharged from the hospital cured. It is an important feature of this case that there was no direct violence inflicted on the spine, the patient, as we have seen, falling on his hands and feet.

Mr. LeGros Clark,<sup>1</sup> calls attention to the fact that a blow on the back sufficient to produce concussion of the cord is not always immediately followed by spinal symptoms. Thus a man who subsequently came under his observation was knocked down by a severe blow with the fist in the upper dorsal region. There was considerable shock produced, and in some thirty-six hours afterwards he began to complain of pain extending downwards from the point where he was struck, and partial paralysis of both arms gradually supervened, attended by diminished sensibility. The lower extremities retained their natural state—a very unusual circumstance, and one in regard to which I think there must be some mistake.

“In another case a young sailor was thrown violently down by catching hold of the revolving wheel of a carriage which violently struck him. When brought to the hospital he made light of his injury, and complained only of a little tenderness on percussion over the upper dorsal region. His breathing was peculiar—a long inspiration followed by a rapid expiration. He soon afterwards vomitted, and during the night had a succession of epileptiform fits, attended by violent tetaniform spasms and unconsciousness. In a few days he was quite well, and was discharged from the hospital.

“Of my own cases the following are interesting, as showing

<sup>1</sup>Lectures on the Principles of Surgical Diagnosis, etc., London, 1870, p. 149.

both how severe an injury may be recovered from, and how slight a one may produce great disturbance without there being at first any very marked symptoms.

"I. S., a young man æt. twenty-two years, while walking a narrow plank about ten feet above the ground, lost his balance and fell in such a manner that the whole posterior surface of the body struck the earth. He was stunned, but more from concussion of the brain than from any immediate injury to the spine. After a few minutes he recovered consciousness and walked to a street car a distance of five blocks, and rode to his home in the upper part of the city. He had no pain except a general soreness, mostly located in the small of the back and occiput, and felt so little discomfort that he went the same night to the theatre, remaining throughout a long performance. The next morning beyond the soreness there was nothing. There was no special pain in the back, and no impairment either of motion or sensibility in any part of the body. But on the third day, on getting out of bed, he experienced a little difficulty in standing and walking, and soon afterwards numbness, characterized by a feeling as if the limbs were asleep, supervened in both lower extremities. He visited me the same day. His gait was then staggering, the esthesiometer indicated diminished sensibility in all parts of the skin below the dorsal region, and the electric contractility of the muscles supplied by the crural and sciatic nerves of both sides was notably lessened. Towards night the bladder became paralyzed, and it was necessary to draw off the urine with a catheter. All the symptoms increased in severity, and in addition there was atrophy of the affected muscles, so that at the end of a month he was unable to stand, much less walk, and could barely flex and extend the right leg. At no time was there any marked pain in the back or limbs.

"He remained in this condition for a month or six weeks longer and then, having in the meantime been, assiduously treated with electricity and ergot, amendment began. This steadily advanced, and six months after the fall he was able to walk with a cane. He is now—somewhat over a year since

the injury—apparently as well as ever, except that the limbs are not quite of normal size, and that he is more readily tired than formerly.

“Another case was that of a gentleman. who, on attempting to raise a window that had stuck fast, felt something apparently give way in his back. He thought nothing of the occurrence till several days afterwards he experienced pain in the lumbar region, and some numbness in the right lower extremity. These symptoms continued without much variation for several weeks, and then one morning when he attempted to rise from bed, he found that he could barely support the weight of the body on the left leg. This weakness passed off during the day to be renewed the next morning with greater intensity. A few days afterwards he came under my observation. He was then suffering with great and constant pain in the lumbar and sacral region of the spine, pain alternating with numbness in the right leg, semi-paralysis of the left lower extremity, especially of the muscles on the anterior face of the leg, which extend the foot and toes, and incontinence of urine.

“Thus far, ten months after the accident, there has been no very decided improvement. The left leg is decidedly smaller than the other, walking is impossible without the use of a cane, and the sphincter of the bladder is still paralyzed, except when the patient is kept under the influence of belladonna. The only amelioration is in the anæsthesia of the right leg, which is almost gone, and this fact affords ground for hoping that the motor paralysis may eventually disappear.

“I have purposely avoided citing any cases in regard to which there could be any doubt, such as might attach to those resulting from railway accidents. In the next place, however, we have to apply the facts recorded in the spinal subject of this paper; and here we shall find, owing to the circumstances previously mentioned, that the course is not by any means a clear one.

“I do not know exactly to what extent railway companies in this country are yearly mulcted in damages for real or al-



leged injuries inflicted by the actual or assumed negligence of their servants; but in the year 1865 the following sums were paid by British companies as compensation for personal injuries done to passengers on their lines: Caledonian, £12,839; Great Eastern, £21,996; Great Northern, £22,387; Great Western, £40,067; Lincolnshire and Yorkshire, £24,708; London and North Western, £30,728; London and South Western, £25,000; London, Brighton and South Coast, £4,504; Manchester, Sheffield and Lincolnshire, £6,483; North British, £4,621; South Eastern, £70,726; Midland, £25,958, and North Eastern, £14,355; a total of £304,816, or about \$1,525,000, and all this in one year.<sup>1</sup> I am inclined to think that the yearly total in this country is not much, if anything, less than this sum.

"In Great Britain the subject of railway injuries has been very much more the subject of discussion in and out of the profession. The little book of Mr. Erichsen—which many have supposed to be written in the interest of the claimants, but which is, I think, fairly and honestly conceived—has been the subject of very severe criticism. No one has commented with more severity on the fraudulent character of many of the claims for damages than Prof. Syme, of Edinburgh, and as showing his own opinion and as expressing my own to some extent, I quote the following remarks from an article which he published in the *Lancet* in January, 1867:

"‘Since the passing of Lord Campbell’s act,’ he says—‘a most unjust piece of legislation as it has always seemed to me—which established the principle of regulating the amount of damages for personal injuries in accordance with the value of individuals to society and to their families, claims of this kind have become very frequent under circumstances which seriously call for consideration. For instance, at this time last year a trial took place at Guild Hall, in the Court of Common Pleas, on the part of a commercial traveler, who prosecuted

<sup>1</sup>Dr. Edwin Morris. A Practical Treatise on Shock, etc. American Edition. Philadelphia, 1863, p. 50.

the Great Northern Railway Company for compensation on account of an injury alleged to have been sustained from an accident on their line. In this case Sir William Fergusson, Mr. Erichsen and Dr. Russel Reynolds declared that there was organic disease in the spine which in all probability would soon prove fatal; while, on the other hand, Mr. Borlese Childs, Mr. Poerok, of St. George's Hospital; Mr. Cook, of Guy's Hospital; Dr. Risdon Bennett, of St. Thomas Hospital; Dr. Dunsmore, President of the Edinburgh College of Surgeons, and myself, no less confidently expressed the conviction that there was no organic disease whatever, and no reason why the claimant should not enjoy good health. The jury, instead of the £12,000 asked, gave £4,700 damages, and before the end of many months the plaintiff, who had been rapidly recovering, admitted that he was quite well, and he still continues to be so. The truth is that when juries find the medical evidence to be so conflicting, not being able to judge for themselves as to the merits of the case, they almost always decide in favor of the claimant, so that there is thus great encouragement afforded to unfounded or exaggerated demands for redress. Indeed, any man who travels by railway may easily obtain a competence by standing on the platform after the door of his carriage has been opened by a servant of the company, but before the train has ceased to move. He has then merely to go to bed, call in a couple of sympathizing doctors, diligently peruse Mr. Erichsen's lately published work on railway injuries, go into court on crutches, and give a doleful account of the distress experienced by his wife and children through his personal sufferings which have resulted from the culpable negligence which allowed him to leave his seat prematurely. Who can doubt that in such circumstances the jury would give large damages? This system ought certainly to be put down, and as one means of doing so I beg to suggest the publication of cases exhibiting an entire discrepancy between the medical evidence, in order that regard for personal character may tend to check the reckless advocacy of one-sided views. The results of such cases in regard to the claimant's speedy

recovery of health would also be worthy of attention for the same purpose; and having given one of these, I may add a case of medical diversity of opinion that has just occurred here. On April 27 last, a commercial traveler drove out in the evening to my residence in the neighborhood of Edinburgh, and informed me that he had been shaken the night before in a railway collision near Berwick-on-Tweed. He had walked immediately afterward a mile and a half to see Dr. Maclagan, of Berwick, and having been assured by him that there was no local injury or occasion for confinement had come on to Edinburgh. Finding that there was no local complaint, I desired him to call next morning at my house in Rutland street, and tell me if he felt anything wrong. He accordingly did so, and then exhibiting the most perfect freedom in all his movements without any sign of local injury, I concluded that if he felt any uneasiness, it must be more mental than bodily. Having expressed my opinion to this effect, I was rather surprised by being asked to recommend a law agent, and it is hardly necessary to say declined to do so. On the same day, April 28, it appears that this person, having procured an accomplished agent, applied to a surgeon of experience in cases like his own, who discovered that he had sustained a severe wrench of the spine and sacro-iliac synchondrosis; the surgeon put him to bed, called in a trustworthy coadjutor, and visited his patient at least once a day for months. On June 12, Dr. Dunsmore requested me to see the claimant as he had now become. We found him lying upon a sofa, from which he rose and walked with vigor and flexibility of body. There was not the slightest swelling, discoloration or rigidity of the spine, and, on the contrary, every appearance of good health, so far as we could judge from our own observation. On July 21, the trial being about to take place, the claimant desired to be examined by a commissioner; and his ordinary attendant having given a certificate on "soul and conscience" that he was unable to appear in the witness-box without serious injury to his health, I was requested along with Dr. Dunsmore to report as to this for the information of

the court. We found the claimant lying or rather lolling on two chairs in a garden, to and from which he walked in leaving and returning to his room, which was up a stair on the drawing-room floor. He told us that he sat at his meals, and on the whole he had no appearance of bad health. We reported our opinion that he could safely appear in court, and the trial was ordered to proceed. But the claimant's legal advisers applied for delay. On December 14, Dr. Dunsmore and I were again requested to see the claimant, as the trial would take place on the 24th. We found that he was not at home; but after a little while we saw him walking stoutly along the street from a public bathing establishment, which it appeared he had frequented for several months. He walked up the stairs of his residence before me, and neither then nor afterward, when more particularly examined, showed any sign of spinal or other disease. At the trial, after the plaintiff had been examined—seated in a chair, not being able to go into the witness-box!—his counsel agreed to accept £1,000, instead of £3,000, which had been demanded. I deemed it unnecessary to offer any observation on this case, but would suggest the following questions: 1. Could any one who had sustained a severe wrench of the spine and sacro-iliac synchondrosis immediately afterward walk a mile and a half, or, on the two following days, travel sixty miles by railway, drive about in cabs and make visits, without local complaint? 2. Could serious disease of the spine, resulting from external violence, exist for eight months without presenting some sign of its presence in the patient's gait, flexibility of trunk, or general appearance?

“Now while I think Prof. Syme's questions will be answered in the negative by the great majority of competent physicians and surgeons, it must be admitted, in view of what has been adduced in the foregoing pages relative to the effects of injuries of the spine when there is no motive for deception, that there are cases of real disease following blows, strains and shocks, in which there are no marks of local injury, and in which the patient could, on the two following days, go about

in cabs and railway trains, and it is this very fact which renders it so difficult to discriminate the true from the false in certain of the cases that come before us as instances of damage from railway accidents.

"As regards many of these there can be no doubt. The symptoms are so very decided and pronounced—so evident both to the lay and professional observer—that there can be no difference of opinion as to their real character. With these we are not at present concerned. We have only under notice that doubtful class of cases in which there is apparently great bodily functional derangement, without sufficiently evident bodily lesion, in which the only symptoms are those the knowledge of which we do not obtain by observation, but by the statements of the patient; of such are the following:

"During the summer of 1875 I was requested by the Hudson River Railroad Company to examine a Canadian woman who had been injured in a collision on their road, and in conjunction with a medical gentleman to be selected by her, to determine finally what damages, if any, should be paid to her by the company. She had been previously examined by the surgeon of the road, Dr. J. W. Ranney, of this city, and it was beyond doubt that she had been injured, and had suffered severely, besides being a good deal of time from her business, that of a milliner, I think. She selected the late Dr. Frank H. Hamilton as her examiner and arbitrator, and together we submitted her to careful and thorough examination. I may here state that she had already instituted a suit for compensation in \$5,000, and that her attorney intended to amend her complaint, and claim \$10,000 for the injuries alleged to have been received.

"Now, at the time the claimant came under my observation there were no objective symptoms whatever. She walked quite as well as most women, and there were no urinary troubles; she complained only of pain in the upper dorsal region, and she winced when pressure was made on the skin over the vertebræ of that part, just as ninety out of every hundred American women do, or rather did several years ago,



when they were accustomed to take less physical exercise than they do at present.

"I think Dr. Hamilton accepted her statements as true, and was inclined to think they indicated serious trouble of the cord. I did not accept her account in its entirety, and admitting its truth, I did not consider the affection indicated as a very important disorder. We, as a compromise, awarded her \$4,000. That she was entitled to something was undoubted, and I thought that sum a sufficient and fair award for the suffering and loss she had undergone. Had the case gone to the jury with Dr. Hamilton's evidence in her favor, she would probably have obtained a much larger sum.

"Now of course I am not criticising Dr. Hamilton's opinion or action in this case. He had just as much evidence in support of his views as I had to sustain mine; such differences of judgment will occur so long as men are not all cast in the same mold. It is too much the custom to associate them to an extreme degree with the members of the medical profession, and the proverb of "When doctors differ, who shall decide?" is continually quoted whenever two or more physicians are at variance. But it must be recollected that the saying was originally applied, not to doctors of medicine, but to those of theology, and that lawyers, aye, even courts—which of all bodies should be without difference—are constantly at variance in their opinions. Even in the very material matter of the strength of materials, the test of a chemical substance, or even the coarse and apparently most easily determined matter of the cost and difficulty of taking down the topmasts of the ships that are to pass under the East River bridge, we find the estimates vary from a few cents to five hundred dollars, and from half an hour's time to a day. I do not, of course, know the line of reasoning pursued by him in getting at his idea of the damage, past, present and prospective, sustained by the claimant I have referred to. My own opinion referred mainly to her past condition, and at the same time I gave her a fair benefit of the doubt I had in my mind in regard to her state when I examined her. As to the future, I was well satisfied

that she could readily be cured, as the very great majority of such patients are, by proper medical treatment. She in fact did entirely recover in the course of a few months.

"Several years ago I was requested to examine a physician who had, as it was said, been injured by a railway collision. I saw him on the part of the company. The evidence was very clear that an actual injury had taken place. At the moment of collision he was standing in the passage-way between the seats, expecting the shock, and when it came he was thrown violently to the floor. He was unable to walk, was carried to a neighboring hotel, and was soon afterwards seized with severe palpitation of the heart and vomiting. He never completely regained his motor power at least he walked with that staggering and titubating gait which is so difficult to assume. He became emaciated, and his general health was much disturbed. The evidence all went to show that he had consistently exhibited these symptoms, even at times when he was not conscious of being observed. But I was nevertheless satisfied that there was every prospect of an ultimate recovery, perhaps after several years, and that certainly there was no such progress of his disease as would lead to complete paralysis. I accordingly so testified, though several other eminent physicians gave evidence to the effect that death would probably ere long result. The jury found a verdict in his favor for, I think, \$8,000, instead of the \$15,000 claimed—a righteous verdict, I conceive, for the patient, though much improved after five years, is, as I learn, not yet entirely restored to health.

"In this case there were objective symptoms—the collapse in the first place, and the emaciation and the consistent lameness which subsequently ensued—so that I felt warranted in testifying that the claimant was undoubtedly injured, though probably not so severely as he and others thought. The result has abundantly satisfied me of the correctness of this view.

"Quite recently I was applied to by a young man, who informed me that about a month previously, in getting off a

street railway car, he had been thrown violently to the ground so that he had wrenched his back, had become partially paralyzed in both legs, and was unable to pass his water without using a catheter. Besides wanting my professional advice, he desired an examination, with the special view of having me testify before a court in a suit for \$20,000 damages, which he intended to institute against the railway company. The fact of the fall was undisputed. I caused him to take off his clothes and I found at once that there was no emaciation. On the contrary, his body was remarkably well nourished. He complained of pain in the cervical region of the cord, and screamed in apparent agony when I touched the spinous processes of all the vertebræ from the third to the seventh. It appeared to me then that there was a very unusual degree of hyperæsthesia. The grasp of both hands was not strong, but on testing him with the dynamometer, the object of which he knew was the estimation of his manual strength exactly, he pressed the instrument with even greater feebleness. I was therefore satisfied that he was making the most of his condition, if not actually deceiving me. I then asked him to walk across the room several times till I told him to stop. He began, and tottered over the floor as if about to fall every step. As he continued walking, however, he forgot himself, as I expected he would, so that after a half a dozen turns his gait was measurably improved. I need scarcely remind the medical portion of my readers that if there had been any serious affection of the cord his walking would have become worse instead of better.

"In the next place I examined him with the esthesiometer, the use of which he did not know, but which I was well satisfied would establish the fact of his contemplated fraud. He had previously informed me that his arms and legs were constantly numb or 'asleep' as he expressed it. If this were really the fact, the esthesiometer would indicate diminished sensibility; if not, the result would be normal. I therefore went very carefully over the skin of both arms and both legs with the instrument, taking a record of the observations, and found,

as I was quite sure would be the case, that there was not the slightest derangement of sensibility in any part of the body. The skin over the spine, which was so painful to my touch, was not in the least degree hyperæsthetic to the esthesiometer.

"This was about sufficient, but there was one other point in regard to which I desired exact information, and that was the alleged paralysis of the bladder. He came to me about one o'clock p. m., and in answer to my inquiry said that he had passed no urine since he rose from bed at seven o'clock, and that he had then used the catheter. Now, it is well known that in paralysis of the bladder the urine becomes alkaline by being retained a long time in contact with the vesical mucous membrane, and that it is sometimes secreted with an alkaline reaction. It was absolutely certain, therefore, that if he had been affected with paralysis of the bladder for over a month, as he informed me, and had passed no urine since seven o'clock that morning—six hours and more—the secretion would be strongly alkaline. I accordingly introduced a catheter and drew off about half a pint of urine entirely free from ammoniacal odor, and on testing it with litmus paper, found it to be of normal acid reaction.

"I then accused him of deception, and recapitulated to him the points which, by his insufficient knowledge of the subject, had led to his detection. After numerous protestations, he confessed that he had been drilled by an attorney—not a member of this society, or of any other reputable organization—to simulate spinal injury, with a view of defrauding the company. Should he ever appear in court as a claimant, he will probably go out of it on a charge of perjury.

"In conclusion, while I think it must be admitted that injuries of the spine may lead to disease, the symptoms of which are all subjective, it is, I am sure, equally true that close observation, a thorough study of the history of the case, and minute examination will often lead to the detection of fraud, if there is fraud. It must be borne in mind that the simulator of the disease generally overacts his part, and that he scarcely ever knows enough of the very intricate subjects of spinal physio-

gy or pathology to play a consistent role. In cases of simulated disease we will usually find, likewise, that the subjective symptoms are more intense than the objective, a condition which, when both classes of phenomena are present, does not exist. It is also very much easier to counterfeit complete than partial paralysis. The fraudulent claimant, not knowing this, attempts the latter, and his irregular movements—for the motions of partially paralyzed limbs present certain definite characteristics which the experienced physician will at once recognize—lead to his detection.

"I am aware that there is much more that could be said on the subject, but if I have not completely elucidated it, I may perhaps have inserted the entering wedge to its discussion and amplification.

"An important point connected with the subject of railway injuries of the spine, is the fact that it not infrequently happens that the patient has been guilty of "contributory negligence." Several years ago a remarkably interesting case in illustration of this fact came under my observation. A gentleman while sitting in his seat was suddenly thrown to the floor of the car with great violence, as he supposed, by being struck by a beam protruding from a bridge or platform that the train was passing. Symptoms of inflammation of the antero-lateral columns of the spinal cord supervened and he suffered greatly from the painful contractions to which his lower extremities were subjected. These were especially prevalent at night, and I found it necessary to keep him stretched out on the bed by fastening his feet to the lower bed-posts while the upper part of his body was firmly secured to the head of the bedstead. In the course of two or three years the acute stage passed off. During the whole of this time he was more or less confined to his bed, and at several periods was in imminent danger of death. Eventually, however, he recovered so far as to be able to walk with crutches, though still suffering greatly from pain in his back and from stiffness, paralysis and contractions of his limbs. He had instituted a suit for damages against the railroad, claiming many thousand dollars for the injuries he had suffered. I was



a witness for the prosecution, for he had all this time been under my immediate charge. The railway company without hesitation admitted the fact that his spinal cord had been irreparably damaged, but alleged in defense that he alone was to blame, and showed very conclusively that he had stuck his elbow through the window at least ten inches beyond the side of the car, and that he could not possibly have been struck had he not done so. The jury at once gave a verdict for the defendants.

"It is quite common for passengers to rise from their seats as soon as the station to which they are going is announced—some obstruction is encountered, or the train is otherwise brought to a sudden stop, and they are thrown to the floor and may suffer severe injuries. How far under such circumstances they are guilty of "contributory negligence" is at present a difficult question to determine. The announcement of a station is generally considered an invitation to get ready to leave the train. I think, therefore, that railway companies would be mulcted in damages for any injuries that might be inflicted under such circumstances. It would be well, therefore, for train hands to be instructed to direct passengers to keep their seats until the train be brought to a full stop.

## CHAPTER XVI.

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### TRANSFUSION.

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This operation is not often performed, for the reason that in many cases bad results have followed, and in many cases it has proved fatal; but it is like many other operations, it is not made until the condition of the patient is such as to convince the friends and the patient that death is certain without it, and the death is not due to the operation so much as it is to the condition of the patient. The operation itself has been of late years made much easier on account of the simpler apparatuses and instruments employed, yet it is an operation with which every practitioner of surgery should familiarize himself, and understand fully the manner of procedure, owing to the critical nature of the cases, and the difficulties attending the operation. There are several methods employed, known as the direct and indirect, the first being where the blood is conveyed directly from one person into another; the indirect is where the blood is separated from its fibrin, or some other fluid is thrown in. Dr. S. S. McCurdy, of Dennison, Ohio, has written a paper on the "Transfusion of Stumps," which appears to have some practical importance, and from which we make the following extracts:

"There is very little room for anything to be said regarding the apparatus used in performing the operation of transfusion. The appliances devised by Garigues, Hutchinson, Roussel and Aveling, the latter modified by Fryer, and the apparatus for

transfusion of defibrinated blood, and for mediate transfusion devised by Hunter, and used by Morton and Allen, have answered every purpose.

"Transfusion would no doubt be more frequently performed were it not for the danger and difficulty attending the operation.

"Dr. Pinkerton, of Bellevue, and others, have been practicing intervenous injection of saline solutions as a means of restoring the vascular equilibrium in acute traumatic anemia.

"The use of saline solutions at 100° F. has proven very beneficial, and is no doubt superior to transfusion into the lymphoid spaces, peritoneum, pleura or subcutaneous cellular tissue or auto-transfusion, but unquestionably the best plan is immediate transfusion of blood from a giver by the Aveling method.

"A Canadian physician (Dr. Hodder) has thrown fresh cow's milk into the veins of individuals suffering with Asiatic cholera, with very satisfactory results.

"Dr. William T. Bull (*Medical Record*, January 5, 1884) tabulates nineteen cases of intervenous injection of saline solution, thirteen of which recovered. There were all varieties of conditions in these cases, as post-partum and ante-partum hemorrhage, anemia resulting from surgical operations, fractures, severe injuries, etc.

"My remarks are intended more particularly for the railroad surgeon, and the method I desire to describe will be found, I am sure, very beneficial in these cases, where our patient has had a leg, or an arm, or possibly two extremities lacerated, many miles from you, and by the time you see him he is perhaps almost moribund, and an amputation is demanded.

"What I want to call your attention to is a new method of inserting the canula, which is done by passing it directly into the vein in the end of the stump and not into the median-cephalic vein, etc., which requires an extra operation.

"Unless the case is very much in need of transfusion we are too frequently found to delay, so that, as Bull says, before we know it, our patient is dead, for we waited until we knew our

patient would surely die, and because he did die, we pronounce transfusion no good.

"This method, as you can see, is easily applicable in cases of capital amputations. Amputations are generally made bloodless by a tourniquet, an Esmarch, Martin or other bandage.

"The principle arteries being ligated, and before the tourniquet is removed, the largest vein of the stump is secured.

"In cases where it is thought at all necessary to perform transfusion, or intervenous injection of saline solution, the canula to be used should be secured in position before the stump is sealed.

"An Aveling apparatus is probably the best for immediate transfusion, and Fryer's modification for the use of saline solutions.

"The essential feature of an Aveling apparatus is a rubber tube about three feet long with two bulbous dilatations in the middle about six inches apart, a metallic stop-cock on either end, with a tip that is interchangeable with a Dieulafoy aspirating needle. The apparatus has two canulas about three inches long, one with blunt and the other beveled tips, which are used for immediate transfusion, the former to be inserted into the givers and the latter into the receivers veins.

"Fryer's modification of the above consists in an additional glass vessel, with the capacity of a pint, with a stop cock at the bottom, interchangeable with the tips on the rubber tubing. For intervenous injection of saline solutions the operation is performed as follows;

A solution of the following :

R <sub>x</sub>	Sodum Chlor,	-	-	-	-	-	5j.
	Potas. chlor.,	-	-	-	-	-	gr. vj.
	Sodum phosph.,	-	-	-	-	-	gr. iij.
	Sodæ carbon.,	-	-	-	-	-	gr. xx.
	Aquæ,	-	-	-	-	f 3xx.	Little. Or
R <sub>x</sub>	Sodum chlor.,	-	-	-	-	-	grms. vj.
	Sod. hydrat.,	-	-	-	-	-	grs. .05.
	Aquæ,	-	-	-	-	-	1 Litre.

Is placed in the glass vessel at a temperature of  $100^{\circ}$  F., with stop-cock closed. The rubber tube is attached to the glass vessel, and the canula to be used is adjusted to the other end or the tube. The stop cocks are all opened to allow every portion of the tube and canula to fill and thus drive out the air, when the stop-cock next to the canula is closed and the canula passed into the end of the vein to be used and secured by the use of a cat-gut ligature. The stop-cock is again opened, and the vessel containing the salt solution elevated, and the desirable amount of fluid allowed to pass into the general circulation.

"In entering the canula great caution must be taken lest a small clot be driven into the circulation, which might cause disastrous destruction to certain portion, of the circulation, resulting in infarctions, etc. All the stop-cocks closed, the vessel removed from the tube, the latter then dropped into a vessel of water which must be kept at a temperature of  $100^{\circ}$  F., the tube still remaining attached to the canula.

"The stump is thus closed with the canula in position for subsequent use.

"If a second injection is thought necessary the glass vessel is again filled and adjusted to the tip on the rubber tube while the water is flowing from it, so as to prevent the possible entrance of air into any portion of the apparatus.

"The wound is closed in the usual manner with gauze, oiled silk, or gutta percha tissue, protective cotton, etc., in such a way as to allow the canula to remain in position and pass out through the dressings. When there is no more need of the canula in position it can be removed as a drainage tube.

"The usual precautions must be taken to insure against sup-puration."



## CHAPTER XVII.

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### ANEURISM.

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#### ANEURISM OF THE FEMORAL ARTERY—LIGATION OF COMMON FEMORAL.

RECOVERY.—By Pinkney French, M. D., Adjunct Prof. of the Principles and Practice of Surgery, St. Louis College of Physicians and Surgeons.

HISTORY.—John Craig, col. age, 40, married, the father of four children. Health good till December, 1888. At this time he suffered an attack of what was pronounced by his attending physician "fever and rheumatism" with a duration of seven weeks. February 15, 1889, patient observed a small growth on the right thigh about the size of a hen egg. In April following he began wheeling mud at a brick yard, and this heavy labor seemed to cause a rapid increase in the size of the tumor. No evidence of specific disease.

EXAMINATION.—September 7, 1889. Temperature normal. Pulse 130. Patient restless. A tumor with distinct pulsation and bruit and about the size of a child's head was situated in the region of Scarpas' triangle of the right extremity slight edema of the entire extremity. On account of pain movement of the limb could not be tolerated. At the apex of the Scarpas' triangle on the left limb was found a similar tumor the size of a small egg.

DIAGNOSIS.—Symmetrical aneurism of lower extremities.

The differentiation was chiefly between solid and cystic tumors developed along the line of the artery and lifted by its pulsation, and malignant tumor of bone whose dilated and thin walled vessels give sound once regarded as pathognomonic of aneurism. Another great danger of diagnostic error lies in the presence of an abscess, and as this growth had been so pronounced an exploratory needle was introduced.

CAUSE.—No evidence of external violence with or without wound, no syphilis, Bright's disease, habitual drunkenness, nor hypertrophy of the left ventricle or tubercle, etc. Chronic Eudarteritis, which is a common affection after middle life, was regarded as the primary cause. Predisposing cause rheumatism.

RE-EXAMINATION.—September 14, 1889. Pulse 140. Temperature sub-normal. Patient exceedingly restless and bathed in a profuse clammy perspiration. Right lower extremity enormously swollen and edematous. Pulsation in the tumor and in the large vessels below the tumor had ceased and the whole limb was perfectly numb and helpless.

Pain controlled by large doses of morphia. Rupture of the sac had occurred and rapid death was inevitable and the danger of gangrene of the parts immediately around the tumor and of the extremity was thereby greatly increased.

PROGNOSIS.—Under the present conditions was very grave. The gravity depending upon the location and condition of the tumor and the physical condition of the patient. The artery could not be reached below the profunda femoris and thereby lessen the danger of gangrene.

TREATMENT.—Patient under observation one week. Consultation with Drs. Adams, Fritts, Halley, Toalson and Nichols.

Immediate relief or cure was not promised by constitutional measures. No hope of a spontaneous cure. Valsalva's starvation process was inapplicable. Judicious and patient compression, which at one time in the history of the case might have yielded most excellent results, was not now to be considered. Flexion, Esmarch's bandage, cautery. The injection of coagulants or the introduction of foreign bodies,

Galvano puncture, etc., were all inapplicable under the existing condition. At this stage of the case there seemed little choice as to the different methods of treatment. That known as the Antyllus method of applying a ligature to both the distal and cardiac side of the tumor with extirpation of the tumor itself was agreed upon. The condition of the aneurism together with the physical condition of the patient practically excluded all other methods.

Ether was administered, an Esmarch bandage was applied firmly to the limb and extending from the toes to the distal side of the growth and there secured. Another was applied lightly over the portion of the thigh upon which the tumor was situated and drawn firmly over the narrow line between the tumor and Poupart's ligament. A longitudinal incision seven inches in length was made directly over the tumor and into the sac, and a large amount of coagula were turned out. The constricting band at the cardiac side of the tumor was then removed, when bright arterial blood gushed through the wound. The hæmorrhage was controlled by digital compression and the bandage on the extremity was laid aside. The incision was extended upwards over but care was taken not to divide Poupart's ligament and thereby weaken the abdominal walls. The muscle and fascia were separated and the vessel reached immediately behind Poupart's ligament. The sheath of the vessel was divided and the crural nerve and femoral vein were pushed to one side. A ligature of strong broad braided flat silk was placed upon the vessel and drawn sufficiently tight to firmly approximate (but not to rupture) its internal coats and to occlude its calibre. The point of ligation was about one and one half inches above the sac. The distended tunics of the vessel in the lower part of the sac were so changed by the progress of the aneurism as to be entirely unrecognizable and a strict search for the opening of the femoral artery at this point did not find it. We could not think that this segment of the vessel was then obliterated but it could not be found. The sac was then carefully dissected out, care being taken not to wound branches of the crural nerve. Part

of the posterior wall of the sac which was much thickened and firmly adherent to surrounding structures was left. It was now observed that a small amount of arterial blood came from the femoral artery when the upper part of the sac had been severed from it.

The ligature was examined and found perfectly secure; we supposed the source of supply was the epigastric or circumflex iliac. The epigastric was sought, ligated with silk and divided between the femoral and the ligature, when the flow of blood entirely ceased. After thoroughly cleansing the wound with hot water its edges were brought together and a drainage tube was placed into its lower part; an antiseptic dressing was applied and secured by an ordinary roller bandage. The ligatures were cut short, not left hanging from the wound.

Almost immediately after the operation the warmth declined and the whole extremity became colder than the rest of the body. The pain, which was so intense previous to the operation, immediately ceased. Cotton batting was applied to the limb, and over this a double blanket. Jugs of hot water, hot bricks, irons, etc., were also used to maintain heat for the limb. The thirst and nausea, which was great, was controlled by champagne and ice and ginger ale and ice. Milk was not given till the third day. A tourniquet for compressing the external iliac was secured, and a trustworthy person left in charge, whose duty it was to watch for the appearance of blood and in that event apply the instrument and send for the surgeon. The upper part of the wound which enclosed the ligatures, as well as the wound through the structures over the sac united by first intention. In the lower part of the wound there was suppuration and sloughing of the Sac, which was washed out daily with an antiseptic solution thrown through the drainage tube.

The discharge gradually subsided, and at the end of a month had ceased altogether. During the first two days patient's pulse was almost imperceptible and could not be counted, but he gradually rallied and his improvement was then steady and uninterrupted. He took no medicine whatever, and his

diet was kept very low during the first month. Seven weeks after the operation the man was perfectly well and with a useful limb.

January 29, 1890.—The aneurism on the left limb has somewhat increased in size.

#### REMARKS.

Tying vessels for aneurism dates from the third century.

"This operation has not as yet been performed sufficiently often to allow of our pronouncing a confident judgment."—*Holmes*.

"More experience is required before the operation can be recommended."—*Bryant*.

Erichson condemns the operation, but Irish surgeons did it successfully.

The higher the operation the more imminent the danger of gangrene. The danger is very remote when the ligature is placed below the origin of the profunda femoris, but if we tie the common femoral, gangrene may be reasonably expected.

Fifty per cent die from gangrene of the parts below the seat of disease; twenty per cent from secondary hemorrhage.

When a limb is edematous, ligature of the main artery is apt to be followed by gangrene. In this case, however, it was the only chance of saving life.

The old teaching, viz: never apply a ligature to a vessel near a large branch, should never be strictly followed.

After ligature, closure of the vessel is produced by retraction and folding in of the internal and middle coats of the artery which were divided by the ligature, also in part by the adhesions to the walls of the vessel of the clots which form immediately above and below the ligature.

We now know that nature by cell proliferation encapsulates the ligature, absorbs, organizes and incorporates it in the tissues of the part.

"A ligature which remains on the artery and does not divide its inner coat, is secure against secondary hemorrhage.



"To do this operation (the Antyllus) much boldness and operative skill are necessary to prevent a fatal hæmorrhage. This practice is only applicable to desperate cases, when all other modes of treatment have failed or are out of the question."—*Bryant*.

## CHAPTER XVIII.

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### THE METHODS OF TAKING CARE OF THE SICK AND INJURED ON FOREIGN RAILROADS.

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Before leaving for Europe in May, 1887, A. A. Talmage, Esq., the general manager of the Wabash, St. Louis and Pacific Railway Co., provided me with a letter of introduction to the officers of foreign roads, stating my relation with this company as local surgeon at Fort Wayne, and secretary of the surgical association, and asking that facilities and opportunities be afforded me to examine their methods of taking care of injured employes. This letter afforded me every opportunity I could have desired for making the examination, and secured for me every facility for carrying forward my investigations. I desire to say that the kind treatment and unreserved attention extended to me by the officers of the railways in all the countries through which I traveled was an evidence of the high standing of our lamented general manager, now deceased, and his subordinate officers, not only in our own country, but in all lands; it was on account of the letter bearing his name and that of the assistant general manager, now general manager, Chas. M. Hays, Esq., that secured for me such great facilities for making my investigations. I have his letter and shall carefully preserve it as a valuable memento.

Railway surgery is rapidly becoming the leading specialty of medical and surgical practice, in foreign lands as well as in the United States, and requires special study and preparation

for the successful treatment of this class of injuries. We found that a majority of the railways in the old country have in their employ a chief surgeon, with many local surgeons; some roads having a surgeon at every station, if only a few miles apart. The chief surgeon is charged with the duty of selecting the local surgeons and recommending them for appointment to the general manager; also of seeing that these surgeons attend faithfully to their duties; and in doing this he is required to give nearly his entire time to the service of his company. He is also required to look after the sanitary condition of the company's coaches, shops and stations. The first railroad office I visited was that of the great Midland route, running through the north of England, and from Liverpool to London. I found the officers very kind and courteous and disposed to advise me freely and fully in regard to the methods employed by their corporation in taking care of the sick and injured. The next large railroad office visited was the London & Northwestern. The officers received me, not as an intruder, but as one coming with a proper mission, and one which they regarded as very important. In conversation with one of the officers he remarked that in view of the great army of men employed in moving the produce of all nations, and also the many hundreds of thousands of passengers who are daily carried over the lines, exposed as they are to the many dangers incident to railway travel, it was, in his opinion, a very laudable undertaking for me to make such an extended tour of investigation; for, said he, the surgery of England has largely to do with cases of an accidental character, and the majority of these are among railway employes.

I shall not take up the time in presenting in detail the methods in practice among the different companies, as they are in the main very near alike. The London & Northwestern, the Great Western, the Midland, the Great Northern and the London, Chatham and Dover railways, with those of Ireland and Scotland, have much the same arrangements. The requirements are that every man, or "lad," entering the service of the company, must be in good health, of sound body, and present

a certificate thereof from a physician of reputable character and standing. He must also pay a weekly assessment to a fund for the purpose of maintaining a provident society, to which each employe, as well as the company, make regular contributions. In case of sickness or injury to the employe he receives a certain fixed amount, or benefit, per week. Provisions are also made that in case a member of his family be taken sick, he shall receive a weekly benefit; and at the death of any member of his family a sum not to exceed, in some cases, twenty pounds (nearly \$100 in our money) is paid as funeral expenses.

The railroads in France, Switzerland, Austria, Germany and Belgium are all operated on much the same principle; having a provident society to which the company makes liberal donations, and requires the servants to make a weekly contribution to the same fund.

I did not find a single road in all my travels where the employes are not required to pay an assessment, and such assessment is invariably deducted from their wages. The London & Northwestern railway has the following agreement, which must be duly signed by the employe and an authorized officer of the company:

#### MEMORANDUM OF AGREEMENT.

It is hereby agreed between the London & Northwestern railway company and —————, who has requested to be admitted to the London & Northwestern railway insurance society, under scale A, as follows:

The employes agree to contribute to the funds of said society a sum equivalent to five-sixths of the premiums from time to time payable by said employe, under the rules of said society; such contribution to be paid to the secretary of said society, where a receipt for the same shall be a sufficient discharge. In consideration thereof the employe agrees to accept such contribution, and any advantage to which he may be entitled under the rules of the said society, in satisfaction

and in lieu of any claims which he or his personal representatives, or other person, or persons, are entitled in case of his death, might or otherwise would have had under or by reason of the provisions of the Employes' Liability Act, of 1880, or any act amending the same. As witnessed, etc.

We give this as a sample of the arrangements made by foreign railway associations for the care of their employes; the company paying five-sixths of this insurance fund and the employes paying the one-sixth. This fund stops all litigation, and provides a fund for the payment of the surgeons and for medical treatment, not only to the sick or injured employe but also to members of his family. The provision is ample and affords a surplus in many companies where they have provided a pension for permanently disabled employes, or those who by reason of the infirmities of old age are no longer able to labor, so that they receive a competence during the remainder of their lives.

It will be observed that the arrangement of these foreign roads is much the same as that of the Wabash and the Missouri Pacific railways in the provision for their sick and injured employes. In this country the hospital plan is much better than the methods of foreign roads. Their injured men are mostly taken to the hospitals for treatment, but as most of the great general hospitals of the old world are supported by voluntary contributions, and as the railway companies are heavy contributors, of course their employes are received in all these hospitals without expense to any one. The hospitals in the old countries are really charitable institutions, and not like so many of our American hospitals, run in the interest of some organization and consequently exacting a fee of five or ten dollars from every patient admitted. This feature is unknown in the hospitals of Europe, for the reason, as I have said, that they are mainly supported by voluntary donations. The majority of railway employes are treated in hospitals; some of course, at their homes. Hospitals are more numerous in Europe than in this country. In almost every small village the traveler will find one, and in some small places



very fine and extensive ones; so that there is no necessity for the companies to build and control their own institutions as it is much cheaper to make donations to the general hospitals along the line of their roads. The charity work is much greater in the countries through which I traveled than in this country,

I may say that the surgeons of these companies are well paid for their services. It seems almost incredible, when men labor for a railway company for twelve shillings per week, which is not quite \$3 of our money, and then compelled to give 6d of this to the provident fund, which is one twenty-fourth of the amount received, that the surgeon who is called to attend them when injured should receive 20£, (nearly \$100) for a minor surgical operation. Yet when we consider that not until after five and in some instances ten years of professional service, as assistant, are the young men permitted to advance to the practice of surgery on their own account, it is not surprising. The young men are not allowed to assume these grave responsibilities until after years of experience as assistant of some skillful practitioner. I once heard Prof. Thad. A. Reamy, of Cincinnati, remark that in this country the young graduate was somewhat like a bumble bee—the largest just when it was hatched. It is not so in Europe. The young graduate must seek some old surgeon with whom he can associate as his assistant, and after years of experience he can assume the responsibility of independent practice. We need not, therefore, be surprised at the liberal fees received by these experienced surgeons, and no doubt the railway corporations fully realize their merit and worth.

It is not necessary for me to present all the methods of treatment employed for railway injuries, as the literature on this subject is becoming more abundant, and every reading surgeon is familiar with the methods employed by the profession on the other side of the Atlantic. I found that in all the hospitals I visited the antiseptic treatment and precautions were strictly carried out. Not in a single hospital in all my travels did I find where these precautions were neglected. I

found a few operators who discarded Listerism, but they were the most careful aseptic surgeons. Having been a strong believer in antiseptic dressing before going abroad, I have returned with a stronger belief than ever in this mode of dressing wounds. In the King's college hospital of London, Sir Joseph Lister is the surgeon in charge, and we saw him operate in quite a number of cases under the improved Listerism or antiseptic precautions. This improved method is in not using the carbolized spray but by irrigating the parts operated on by the bi-chloride solution and continuing until the operation is completed, then applying the antiseptic gauze with the iodoform. It is very strange that any surgeon who has had the opportunity to observe the good results in cases where these precautions have been observed, and the frequent bad results where they have been neglected, should oppose antiseptic dressing in surgical cases. There is no doubt that the pure atmosphere has much to do with the success attending the operations of Mr. Lawson Tait and George G. Bantock, M.D.F.R.C.S., Edinburgh, but now of London. While in London, during the early part of July, we found that in the meat markets of that great city, the meat was not kept in ice boxes or refrigerators, but was hanging out and not a fly could be seen; and we were informed that the meat could be kept quite a number of days without becoming tainted. In the cities of Bradford, Leeds, York, Sheffield, Birmingham, Coventry, Stratford-On-Avon and Liverpool we noted the same thing, thus showing that the putrefactive elements, or germs, are not in the atmosphere as they are in this country, and we concluded that an operation made in such an atmosphere would certainly do better without the antiseptic precautions than it would in this country, in most of our cities, where the putrefactive elements are so very abundant that fresh meat exposed for only a few hours will become tainted and offensive. I have not seen any reference to this matter by any surgical writer, but from personal observation believe it to have much to do with the success of surgical practice in England. While in Paris I was invited to examine

a sanitary train made and used by the Paris, Lyons & Mediterranean railway. This train is made for the purpose of transporting sick and injured employes, and also sick passengers.

No doubt it was originally intended for the transportation of wounded soldiers, and from the indications the time is not far in the future when it will again be used for that purpose. The arrangements of this train were excellent but might still be improved upon. A train of this kind would certainly be of great value on the railroads of this country. One coach at each superintendent's headquarters or at each hospital would certainly be a great benefit in the transportation of sick and injured passengers or employes. It is very unpleasant for passengers to be compelled to travel in company with those who are moaning, coughing, expectorating, vomiting and sometimes dying; and all this is equally as annoying to the afflicted. I became very enthusiastic over this sanitary train, and prepared myself with all the plans, so that if this or any other company shall desire to adopt or provide such a train the plans can be furnished. In connection with this I found in England that the railway men are taught by some of the members of the St. John's ambulance corps, which has its headquarters in the old St. John Gate in London, how to render first aid to the injured, and there must be one on each train who does so understand, and who holds a certificate of competency from the surgeon appointed to impart this instruction. In Scotland there is the same requirement, but the work is under the supervision of the St. Andrews ambulance association. I took a special course in this important work and I believe that a course of lectures at each division headquarters would be advantageous and profitable to the men. Many valuable lives might be saved if it was generally understood what to do until the surgeon arrives. This feature should be introduced on all of our railways. In England and Scotland, railway men are fairly instructed by a few lectures given by one of the surgeons of the ambulance association at intervals of every two or three months.

I desire to say that all railway officials whom I met treated me with the utmost courtesy and cordiality. I cannot omit special mention of the directors at Berne, Lausanne and Zurich, Switzerland; at Vienna, Austria, and Berlin, Germany. One thing I found to be especially pleasant, and that was my meeting with the general managers, who always extended me a cordial greeting and afforded me every opportunity to secure desired information. I trust that my visit, through the valuable items gleaned, may result in good to the railways of this country, and in some degree prove a blessing to our great army of railway men.



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